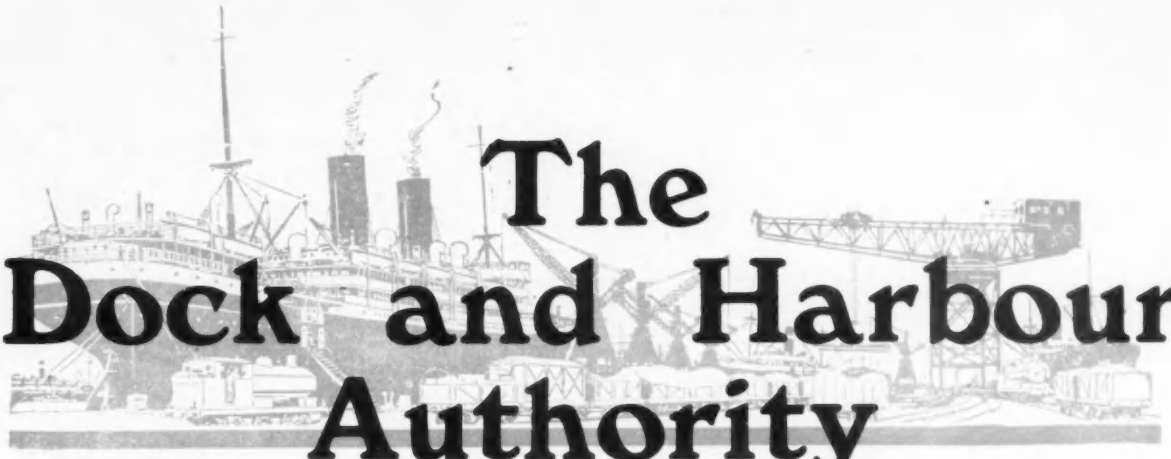


The Dock and Harbour Authority

No. 280. Vol. XXIV. Edited by BRYSSON CUNNINGHAM, D.Sc. B.E., F.R.S.E., M.Inst.C.E. February, 1944

CONTENTS

Editorial Comments

Southampton: Sea Port and Air Base.

In this month's issue we present two aspects of the future Port of Southampton: first, the traditional aspect of a great commercial and passenger sea port, and secondly, its ambitious design to become an equally important factor in future air transport.

The seaport has often figured in the past by means of plan, photograph and textual description in the columns of this Journal. Indeed, in view of its pre-eminent pre-war position as the leading passenger port of the United Kingdom, this was no more than its due and the same consideration affords sufficient justification, if any be needed, apart from its own intrinsic merit, for the inclusion in this issue of a report of the interesting address, or " talk," to the Southampton Civic Society recently given by Mr. H. A. Short, the Docks and Marine Manager of the Southern Railway Company, in which there is an up-to-date review of the many and varied activities of the port.

But Southampton is making another, and even bolder, bid than her achievements in the past for further popularity and future prosperity. In addition to Mr. Short's address, this issue also contains a statement of the scheme for a Sea Aerodrome and Air Base combined with a Land Aerodrome, which has been prepared after full consideration of the site, and discussion with all the interests concerned, by the Special Air Base Sub-Committee of the Southampton Harbour Board, consisting of Alderman Sir Sidney Kimber, Chairman, Mr. Harry Parsons, Chairman of the Board, Squadron-Commander J. Bird and Messrs. C. E. Cotterell and M. G. J. McHaffie, the last-named being the Docks Engineer at the port. These names obviously carry considerable weight and the result of their collaboration, with which, naturally, the Harbour Engineer, Mr. J. P. M. Pannell has been associated, as also the Clerk (Mr. O. H. Lewis) and the Harbour Master (Captain F. W. Frampton), is given in a succeeding page. Our readers will find it an absorbing report replete with interesting features.

There can be no question about the favourable position of Southampton as a site for an aerial sea-base. Southampton Water provides a naturally broad expanse of tranquil surface, sheltered by the Isle of Wight, with ample scope for the manœuvring of air craft, either when taking-off in different directions, or when approaching from seaward. At one time, it seemed as if there would be keen rivalry with Portsmouth in this respect, since Langstone Harbour provides an equally expansive and naturally sheltered land-locked water area. No inconsiderable advantage, however, lies with Southampton in its traditional association with transatlantic passenger traffic, and its existing commercial institutions and port facilities which are operated by shipping lines already possessing powers to run world-wide air services.

Shipping and Air Competition.

The fate of shipping, or rather the nature of its evolution after the war, continues to be a burning question in maritime circles and, in particular, how far shipping is likely to suffer in competition with commercial aircraft. The fact that it is bound to feel the effects of this competition is openly recognised on all sides, but opinions differ as to the exact extent to which seaborne carriers will be superseded by aeroplanes. Public pronouncements on the subject have been many and various and port authorities in their attempts to provide for the needs of the post-war situation are not unnaturally perplexed by these divergent views.

The question presents two distinct aspects; first, as regards passenger traffic and secondly as regards freighters. For the moment the former assumes greater importance.

One of the latest utterances on the passenger aspect of the subject comes from an American expert, Mr. John E. Slater, executive vice-president of the American Export Lines and of American Export Airlines, Inc., in an address to the Propeller Club of New York. Mr. Slater, as reported in the New York *Journal of Commerce*, stated that the results of his study of the probable effects of air competition indicated that ship operators would lose to the air services forty to fifty per cent of the first and cabin passengers who used to travel to Europe and the Mediterranean by water, fifty to sixty per cent of the same class passengers going to the West Indies and Central America and sixty to seventy-five per cent of high class passenger traffic on the South American service.

In a roughly general way it may be conjectured that British shipowners will be affected to much the same extent, and will lose, at least, one half of their luxury passenger traffic. Incidentally, Mr. Slater gave it as his opinion that the inroads of air traffic on passenger-cargo, as well as on passenger, shipping would be so great as to " doom " the 10,000-ton ship carrying 100 passengers, with 100,000 cu. ft. of cargo capacity, at 16 to 17½ knots and

Editorial Comments—continued

probably make it unprofitable to operate a 20,000-ton 21-knot ship carrying 500 passengers, with 500,000 cu. ft. of cargo space, " even assuming the maximum Government construction subsidy."

This points to the coming elimination of the large luxury liner and the question arises how will it affect port accommodation.

In a lecture on Maritime Passenger Stations, delivered in 1936 to the Institute of Transport by the Editor of this Journal, it was shown, with exemplification by a number of lantern slides, that waiting-room accommodation and travelling amenities for ocean passengers at British ports were, generally speaking, much inferior in style and quality to the elegant appointments provided at the newer installations of continental ports, and in the ensuing discussion, it was admitted by a competent speaker that there was a good deal of leeway to be made up at British passenger ports. It is now a moot point, whether it will be necessary or desirable to incur any heavy expenditure on this particular feature of port equipment. If passengers arrive and depart by seaplane, no doubt there will be a demand for superior terminal amenities and comfort at British ports, but if, on the other hand the bulk of the high-class traffic is by aeroplane to aerodromes situated inland, the necessity would no longer arise, though, of course, the possibility of aerodromes for land-based machines being located in the vicinity of ports should not be overlooked.

As regards cargo carriers, the position is different, and Mr. Slater gave it as his opinion that the optimistic estimates of some air enthusiasts were not justified. We agree that the slower and less spectacular type of water-borne carrier is likely to maintain its place in sea and ocean traffic for some time to come. If this view is correct, port authorities will still have to provide docks and quay shed accommodation and equipment on about the same scale as before, though the absence of the ocean leviathan, built mainly for passenger service propaganda, will reduce the need for graving docks and floating docks of outstanding dimensions. But we think that there will be a demand on economic grounds for improved cargo-handling equipment and a more rapid turn-round of ships. Essentially, the ship is a conveying and travelling machine, and every hour spent tied up alongside a quay, or wharf, represents an unremunerative loss of interest on her capital value and an increase in overhead expenses. Rapidity of port operation will, therefore, become a factor of great importance in the economic struggle.

Reduction in Port Labour Charges.

It is welcome news in commercial and shipping circles that certain port labour charges at London and Southampton, have been reduced. The step is the outcome of a reduction in the rates of percentage contributions payable to the National Dock Labour Corporation and is attributable to the highly successful year's operation of the Corporation in 1943. From the point of view of the community at large the reduction is equally welcome, since, in the ultimate issue, it tends to bring about a lowering of the cost of living which, for the last four years, has been steadily on the up-grade, owing principally to repeated demands by labour for higher rates of pay. These demands have often had to be conceded in spite of their detrimental economical repercussions. Any increase in the cost of goods-handling at ports is bound to be reflected in the market price of the goods themselves—a fact which the labouring man is too obtuse to see. His reaction to higher prices is merely a demand for more pay.

Development of the Port of Buenos Aires.

The Port of Buenos Aires, and the channels of the River Plate Estuary by which it is approached, have been the subject of several articles in this Journal, and from them our readers will have gathered a good deal of information about certain problems affecting the future development of the leading port and chief city of Argentina. In particular, our readers will recall a report of a lecture delivered in April 1939, by the Argentine Director-General of Navigation and Ports, Señor Ernesto Baldassari, on his project for providing sectional port accommodation for coastal traffic and a riverside station. A translation of the lecture appeared in our issues of March and April 1940. A Paper on the Channels of the River Plate, also by Señor Baldassari, followed in the issue of January, 1941; while there have been earlier articles on the port and its accommodation for shipping (July 1933 and November 1920). The future of the port continues to arouse considerable discussion in the South American Press, various opinions being ventilated in the *Times of Argentina* for the guidance of the authorities.

Among the latest contributions to that Journal is one by Mr. Robert Veitch in which he calls attention to the difficulty of adapting parts of the present port accommodation to large ships of the "Victory" class, as these, he alleges, are too broad in the beam to enter docks 1, 2 and 3. He goes on to say;

"The New Port is logically going to become, immediately after the war, the hub of the commercial oversea traffic, as the North Basin in certain sections leaves no water under deep draughted vessels for them to remain afloat. Something ought to be done about dredging the basin. These sections (New Port, North Basin and Dock No. 4) will have to bear the brunt of the traffic, and if we enjoy the inward and outward movements that those of us who live and work in Buenos Aires would like to see, there is going to be chaotic congestion unless remedied in time.

"Then another trouble is going to be the entrance of ocean-going vessels by the South Channel and something will have to be done about deepening and widening the channel for the passage of heavier craft which use it for going into the South Basin and South Dock. These sections of the port will also have to be dredged to allow ships to lie safely afloat while discharging and loading."

We have no exact knowledge of the data on which Mr. Veitch bases his strictures, but it was evident from the opinions previously expressed by Señor Baldassari that dredging problems constituted the particular difficulty of the port of Buenos Aires, and although it was claimed some four years ago that adequate depths for shipping had been maintained in the port approaches, there is a possibility that war-time conditions have seriously interfered with the satisfactory prosecution of operations.

As regards the general question of port development, Mr. Veitch urges the despatch of a special technical commission to study the steps being taken at foreign ports to meet modern traffic conditions. The concluding paragraphs of his article are:—

"While talking about constructing or reconstructing ports, I think the authorities should make a thorough study of the possibility of building special piers, with storage facilities, with a view to leasing them on long-term contracts to regular lines for discharging, loading and storing cargo they handle. This, no doubt, would be the means of accelerating loading and discharging operations.

" It seems possible that the days of the tramp ship, on which the bulk of the River Plate traffic has hitherto been built up, will tend to fade away in favour of the cargo-passenger liner. These liners will probably take the place of the cargo tramp and thus introduce an interesting new phase in River Plate traffic. In this way the cargo-liner will be the governing factor in freight rates, both in the inward and outward River Plate trade, and those rates of freight will be determined in the light of operating costs at each individual port—in other words, a slow port will carry a higher rate of freight. Thus Buenos Aires will find itself in competition with Montevideo and Brazilian ports in regard to what her freight is going to cost, and if national economy is to benefit it is of utmost importance that plans be already studied to make the port of Buenos Aires not only equal to her neighbours but to surpass them in every way."

The observations of Mr. Veitch are of considerable interest, especially as regards the development of South American seaborne trade, and if his deductions are well-founded, the Argentine Port Directorate will be under the necessity of taking early measures to improve the port accommodation at Buenos Aires.

IMPORTANT NOTICE.

By an unfortunate mischance, two pages in the January issue were transposed and readers are requested to note that the sequence for reading should be—page 200 after page 198, with page 199 next in order. If they are intending to have their copies bound, perhaps they will make a note to that effect in the copies.

*The Future of Southampton as a Seaport**

By H. A. SHORT, M.C., Docks and Marine Manager, Southern Railway, Southampton Docks.

FOREMOST among the problems requiring urgent solution with the conclusion of hostilities will be that of rehabilitating the devastated areas of Europe, and the successful tackling of this problem will depend largely upon the speed with which supplies can be brought to the Continent. To this end the most effective use of services—by sea, land and air—will become factors of paramount importance.

European Problems

Apart from this essential reconstruction work the transport industry will have to contend with demands resulting from the natural reaction to war-time suspension and restriction of normal movements of merchandise and passengers, particularly by sea. Further, it must be remembered that the situation obtaining at the cessation of hostilities will call for large scale re-adjustments of the military forces of the allied nations.

The future of Southampton's maritime trade will, undoubtedly, be greatly influenced by the factors outlined above. The port's situation in relation to the Continent of Europe and the principal overseas trade routes make it a focal point on what must become one of the world's busiest trade channels in post-war years. The enviable reputation achieved by Southampton in pre-war years for speedy discharge, loading, and turn-round of shipping emphasises still further the value of the Port in relation to post-war shipping trade.

Mr. H. A. SHORT, M.C.

Southampton's Pre-War Status.

A brief reference to Southampton's status amongst British ports prior to the outbreak of the present war, and to the Port's facilities, will enable one to obtain a more clear perspective regarding its future possibilities. In pre-war years consistent advance registered in both its passenger and cargo traffics had gained for it the distinction of being the United Kingdom's No. 1 Port for ocean passenger trade and one of the leading six ports in regard to the value of merchandise traffic dealt with. It was also one of the principal cross-Channel ports with a network of shipping services linking the near European countries of France, Belgium, Holland and Germany with Britain. A number of these services were in the nature of " feeder " links with the ocean shipping services based on the Port. There would appear to be ample scope for the fuller development of this last-mentioned phase of the Port's activities in the post-war era, particularly in respect of the despatch of supplies to the Continent from overseas via Southampton.

The quantity of shipping tonnage entering and clearing annually at the Southern Port was exceeded by two other British ports—London and Liverpool—only, while the Port held a similar distinction in relation to the country's transhipment trade.

Reference to the Port's present eminence merits mention of the great contribution made by the dockowners in the matters of port improvement and provision of docks and quayside equipment. Since the acquisition of the Docks by the L. & S.W Railway Company more than fifty years ago the Undertaking has been extensively developed by railway enterprise and most notable additions have been made to accommodation by the Southern Railway Company, the present successors to the original railway owners. Generously endowed as Southampton is by a splendid natural harbour, with the phenomenon of double tides which result in the period of high water lasting about 2 hours, much of its success as a seaport must be attributed to the enterprising policy and foresight which have reinforced the Port's natural advantages and allowed it to keep abreast of all trade requirements. Thus the Docks Extension Scheme, commenced in 1927 and completed seven years lated, added 7,000-ft. of deep water quays to the existing docks and provided ample accommodation for new-acquired shipping traffic besides making allowance for the future.

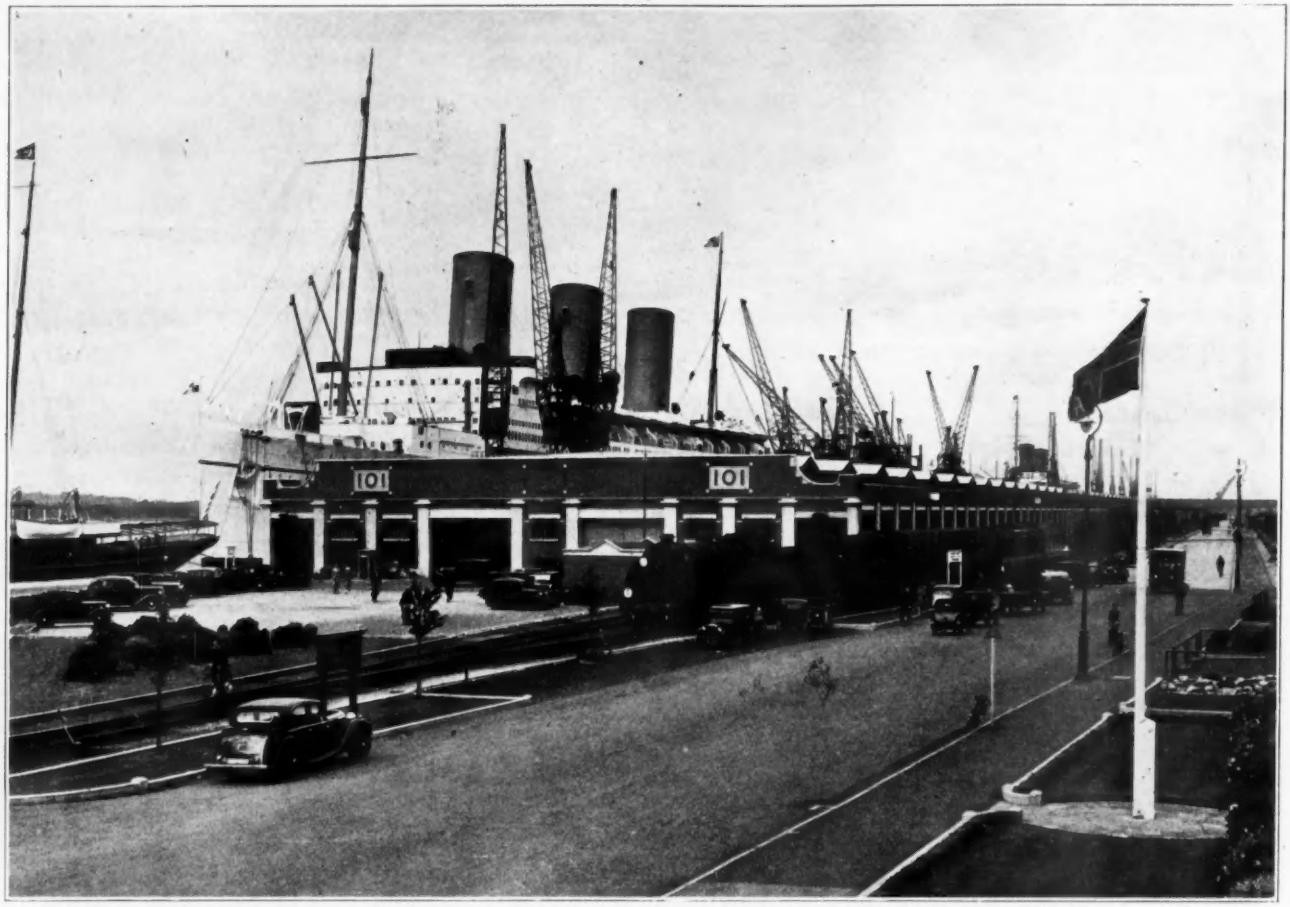
Equipment at the Docks is of the most modern type and fully adequate for all needs. For example, for the loading and discharging of ships, electric quay cranes range in capacity from 2 to 50 tons, whilst for the overhaul and repair of vessels, there are seven graving docks, including the largest in the world. Transfer of cargo between ship and transit shed or rail wagon is expedited by the utilisation of electrically-powered trucks of 2-tons lifting capacity. A railway owned and managed undertaking, Southampton Docks has unsurpassed direct rail connections with all parts of Britain, while on the Docks Estate itself rail lines run into transit sheds and along all quays.

The proximity of the Port to the Metropolitan markets and its central situation on the coast of Southern England enables traffic routed via

* " Talk " on the occasion of the Annual General Meeting, Southampton Civic Society, 7th July, 1943.

South African Citrus Fruit in Shed 101.

The Future of Southampton as a Seaport—continued

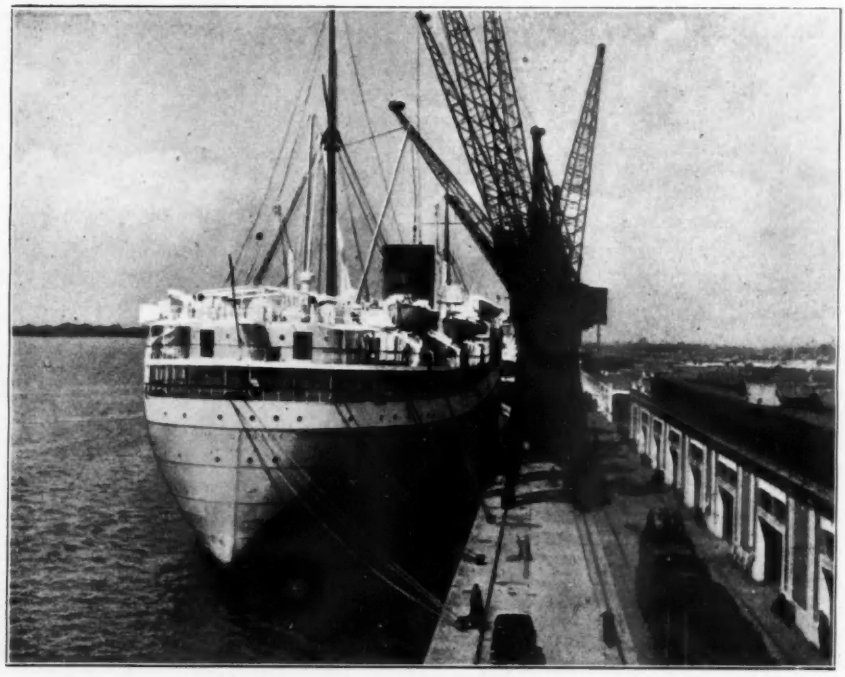


View of Docks Extension, showing Herbert Walker Avenue and "Empress of Britain" at 101 Berth.

Southampton to reach a hinterland of 16 million persons within a radius of 100 miles. London, only 78 miles distant, can be reached within three hours by express freight train from the Docks while special boat trains convey passengers to the Capital within less than two hours.

Development of a Marine Air Base

With the rapid development of air transport in the years immediately preceding the present war the advantageous situation of Southampton in relation to principal world centres received further recognition when Britain's Marine Air Base became established at the Port. In 1937 the facilities at the Docks were utilised by Imperial Airways, Ltd., in connection with the operation of flying-boat services linking many parts of the Empire and so successful was this venture that in the following year, air traffic figures showed an increase of practically 100 per cent. Just prior to the outbreak of war the increase of air services from the Port received further stimulus by the inauguration of a North Atlantic season service with New York. This last-mentioned development was jointly operated by Imperial Airways and Pan-American Airways and but for the commencement of hostilities, there is little doubt that its success would have been assured, thereby greatly consolidating Southampton's position as the premier Marine Air Base of the United Kingdom.



Union Castle Liner at Southampton Quay.

The Future of Southampton as a Seaport—continued

Industrial Sites

A factor which may well prove of importance to Southampton's seaborne trade in the post-war period is the comparatively recent provision, by the Dock Authorities, on an area contiguous to the dockside, of sites for industrial premises. The planning of this industrial estate, enjoying the advantages of direct rail, road and water transport facilities, is another instance of the foresight and enterprise displayed by the dock owners. Within the first few years of the laying out of these industrial sites the establishment thereon of Flour Mills, Motor Car Assembly Plant, Saw Mills and other premises testified to the success of the venture.

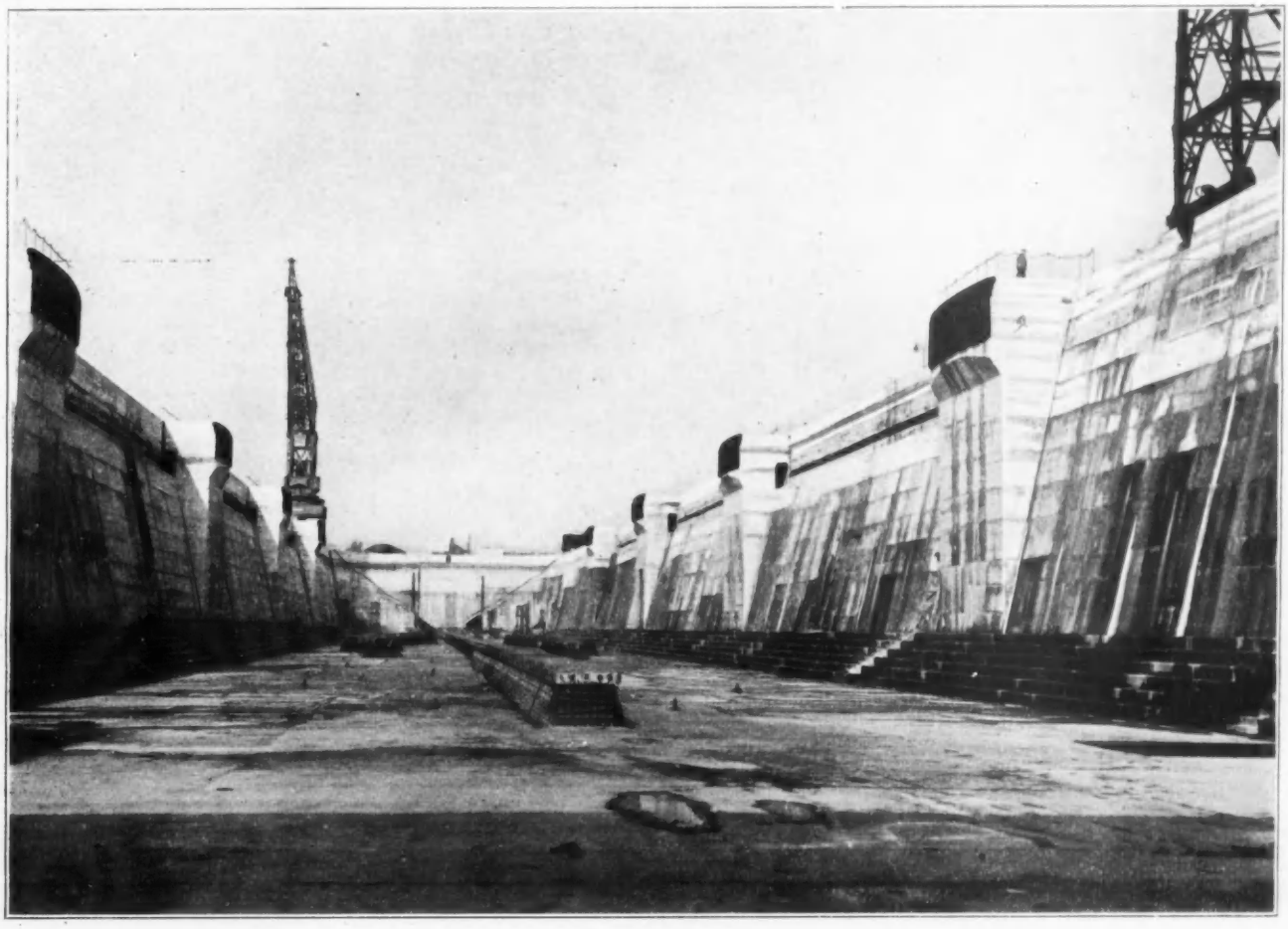
Future Prospects.

On most of the trade routes with which Southampton was intimately associated in pre-war years, the North and South American routes, the South African route, and the cross-Channel routes to France and other Continental countries, there is the prospect of heavy traffic materialising with the coming of peace and, without doubt, the facilities at the Docks will be well utilised by the flow of traffic—mainly from overseas to European centres. A number of the Continental ports will probably be unable to function fully for some time owing to the effects of bombing, etc., and in this respect the proximity of Southampton will render it extremely useful as a port of transhipment for European cargoes. Bearing in mind the steady progress recorded in the Port's freight trade during the past few decades and the great impetus which will be given by the resumption of normal commercial activities it may be assumed with confidence that Southampton's outlook is particularly bright.

In spite of post-war developments in methods of transportation affecting passenger traffic there is every reason to suppose that the general increase in ocean passenger movements after the war will be such as to result in very little, if any, diminution with pre-war standards. As a liner port Southampton affords the finest dock facilities for the class of vessel engaged in this traffic and its direct rail communication allows the passenger to step from train to ship without intermediary delay.

For many years the Port has been the chief United Kingdom depot for the despatch of troops to overseas stations and during the European War, 1914-1918, it was Britain's No. 1 Port of Embarkation for military personnel. Throughout those four years more than seven million troops embarked and disembarked at the Docks and several million tons of military impedimenta and stores of all descriptions were handled over the quays. In the post-war era Southampton will, no doubt, once again assume its former role in connection with the annual trooping season while its experience in this respect will prove of great value when the time approaches for the dispersal of the allied forces now engaged on active service on the various front.

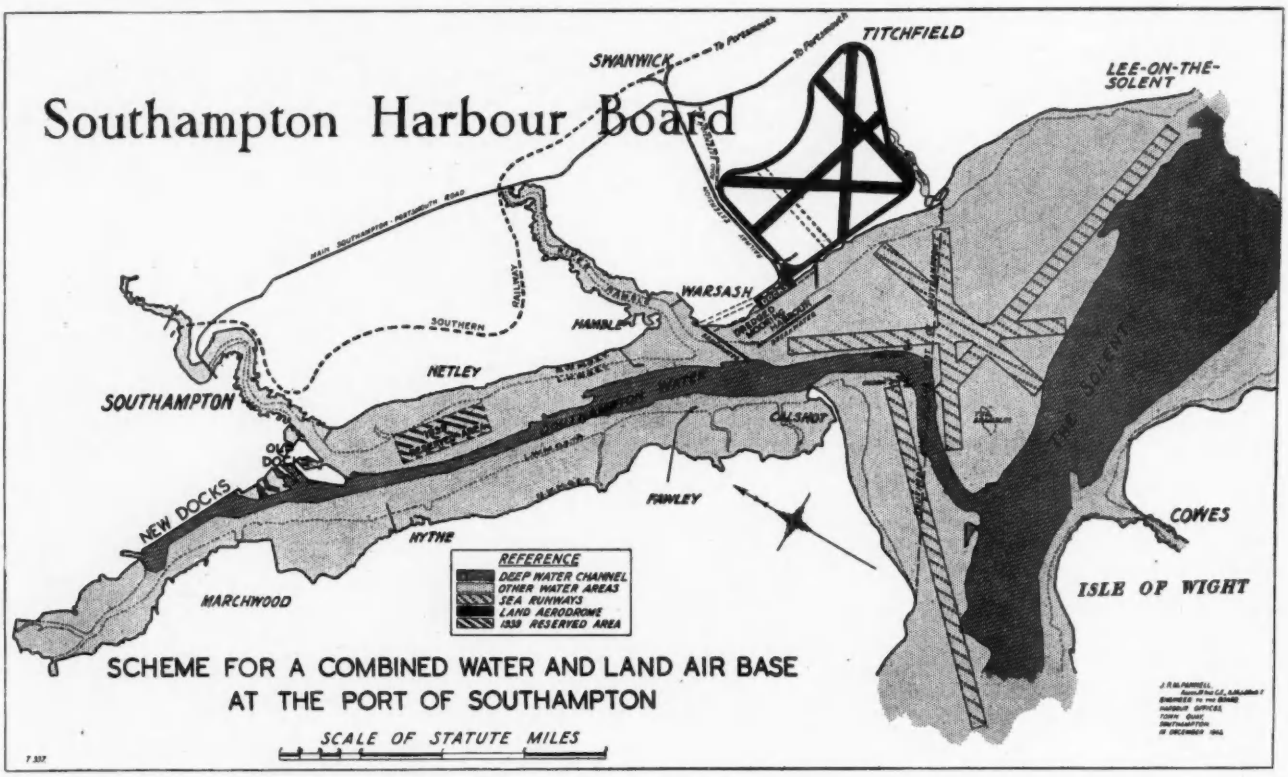
It must not be overlooked that any assessment of post-war prospects concerning this or any other Port's trade must be contingent, among other things, upon the situation obtaining in the shipping industry and the quantity of tonnage available to meet requirements. With this reservation in mind it would appear that Southampton can look forward with every confidence to a long period of prosperity in its maritime activities during the years that lie ahead after victory has been won.



King George V Graving Dock, Southampton.

The Air Port of Southampton

Scheme for a Sea Aerodrome and Air Base, combined with a Land Aerodrome, prepared by the Southampton Harbour Board with the approval of the Director-General of Civil Aviation



Foreword

THE Southampton Harbour Board has been actively engaged for many years in endeavouring to provide in Southampton accommodation for civil aviation comparable to that which has been provided for shipping. In pre-war days Southampton was the terminal for the Empire Seaplane Air Services and for certain preliminary Trans-Atlantic crossings made by the American "Clippers." At that time an area of Southampton Water was reserved by the Southampton Harbour Act, 1939, for the exclusive use by seaplanes, but having regard to the increase in size of aircraft since that date, and to probable further developments in the future, it is certain that such area will be too small for post-war air services. Moreover, the area referred to was not adjacent to terrain suitable for a land base.

Furthermore, it is considered essential that the Sea Aerodrome and Air Port should be contiguous to a Land Aerodrome and this scheme, therefore, has been prepared to show that an Air Base combining water with land facilities, adequate and suitable in all respects, could be established at the Port of Southampton.

It is desired to emphasise that the Board has taken a National outlook in preparing this scheme and feels that the needs of the Empire necessitate co-operation with the Air Ministry and other interests such as the Admiralty, The Trinity House, The Southern Railway Company, and various adjoining Town Planning Authorities with a view to sponsoring the finest possible Combined Air Port for the South of England.

Location

The desirable features of a combined Air Base include firstly, an adequate area of comparatively quiet water, and secondly, an adequate area of reasonably level land immediately adjoining the water, both water and land being of sufficient extent to accommodate poly-directional runways of considerable length and width.

After considering all the possible combinations of water and land sites within the Port of Southampton, the Board is definitely of the opinion that the best is to be found in an area of water at the conjunction of Southampton Water and the Solent, with the adjoining land bordered by the River Hamble on the north-west and by the River Meon on the south-east and that such site contains the desired features in a marked degree.

Sea Aerodrome

The water area in the Solent recommended, while open for easy approach and departure of aircraft, is so sheltered by the Isle of Wight that it forms, with the seaward end of Southampton Water, a natural "all way" sea aerodrome.

Runways of great length, i.e. 2½ to 5 miles or more, and of adequate width, can be laid out in all directions clear of the main shipping channel and with ample depth of water.

In order that seaplanes may have safe harbourage for mooring, it is suggested that breakwaters be constructed having openings of adequate width to provide easy entrance and exit for craft of large wing span. Within the seaplane harbour and along the foreshore, covered docks with pontoon landing stages would provide for easy embarkation and disembarkation of passengers; for the loading and unloading of mails, baggage and freight; and for servicing as required. Slipways would also permit the hauling up of aircraft for periodic surveys, overhauling and repairs, and ample ground areas exist for the provision of hangars, workshops and similar facilities.

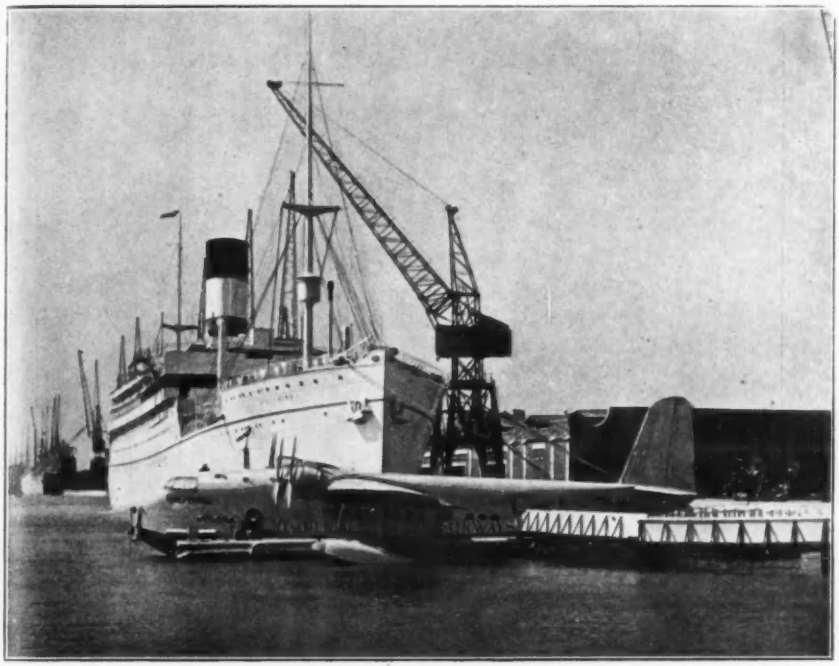
The Air Port of Southampton—continued

The existence of the Calshot seaplane base so near the suggested water area, provides the immediate facilities required for servicing and repair of aircraft and as a "control" station. In the event of this scheme being developed, the Calshot facilities could be used until such time as the permanent control buildings of the combined base are built on the Hamble-Titchfield shore, or alternatively might remain as a permanent feature of the scheme.

Land Aerodrome

Nature and Contour of Ground

The site is of a gravelly nature and suitable for the construction of first-class runways.



Imperial Airways Flying Boat at Landing Stage, 101 Berth Extension. May, 1938.

The ground slopes slighty toward the sea and the area recommended has no violent undulations calling for heavy engineering works. The average level is sufficiently high above sea level to facilitate drainage, while at the same time the elevation is such that aircraft could take off with the shortest run.

The area is mainly farmland and is very free from obstructions. The slopes being easy, a great variety of patterns of runways may be worked out. This is one great advantage of the site as the aerodrome designer is not confined to three or four runways dictated by nature. It is therefore possible to lay down runways which will fit in to the general layout of buildings, comunications, water frontage, etc. The extension of the runways at some future date is also possible.

The site being contiguous to the water area proposed for the sea runways, most, if not all, services may be common to both land and water aircraft.

Rail, Road and Water Communications

It would appear to be possible to construct a branch line about four miles long from near Swanwick Station on the Southampton-Portsmouth line of the Southern Railway to the main aerodrome buildings on the water front. Thus connection with the main line services to Victoria and Waterloo could be established.

The main Portsmouth-Southampton road might also be connected at one or more points.

Water communications are easy in all directions and may be developed as required. In particular, Southampton Docks could be reached by fast motor launch.

Other Services

As the site is near major towns, the provision of electricity, gas, and water services would be a matter of arrangement with the appropriate authorities.

Local Facilities for Building and Civil Engineering Works

There is an adequate supply of gravel for concrete manufacture immediately adjacent to the site and the setting up of a large scale plant for this purpose should present no difficulty.

The distance from Southampton and Portsmouth is short and suitable labour could be obtained from these areas. Rail and road borne materials could be handled, if necessary, by the augmentation of present communications.

Terminal Facilities

All the terminal facilities such as control and administrative buildings, customs and railway and road terminals could be established on any scale required. Ample land of a suitable nature exists for the development of workshops, factories, hangars, fuel storage, offices, and all ancillary services required by an aerodrome.

The site for the land aerodrome is amidst rural surroundings and therefore an ideal one for the establishment of hotels.

Authorities Controlling the Water and Land Areas involved in the Scheme.

Water Area

The seaward boundary of the Port of Southampton is an imaginary line drawn from Hill Head to Stansore Point, therefore the whole of the seaborne base would be in the area under the jurisdiction of the Southampton Harbour Board and a large portion of the Seadrome.

Certain of the proposed water-runways extend over water controlled by the Admiralty and The Trinity House.

Land Area

The following Authorities have jurisdiction over the area of land sited for the land aerodrome.

The Southampton County Council.
The Fareham Urban District Council.
The City of Portsmouth Planning Authority.

Conclusion

The Air Base suggested by this report would be situated close to the principal Passenger Gateway to the United Kingdom and on one of England's finest waterways. The site has the advantage of being far removed from any large industrial area and is therefore free from smoke and is in an equable climate.

It is conveniently placed as regards distance from London, the actual mileage being as follows:—

Rail	... ...	77
Road	... ...	75
Air	... ...	56 (Heston).
		60 (Croydon).

The site is in close proximity to Southampton Docks and to the existing civil seaplane base which is being used in connection with overseas air services.

The Port of Southampton has had long association with trans-oceanic passenger traffic, and therefore contains all the ancillary activities necessary for the successful operation not only of sea but of world air transport. The principle shipping companies have powers to run air services, and many of them are based on the Port of Southampton.

The local aircraft industry is of sufficient magnitude to provide adequate personnel and facilities for the building up and maintenance of repair and other services.

The Board Room.

The Board Room of the Manchester Ship Canal Company

The photograph on this page, kindly supplied for the purpose, shows the Board Room of the Manchester Ship Canal Company, with the Directors in session on a recent occasion.

Taking them in clockwise order from the left hand side of the photograph the directors present were: Councillor Samuel Meadowcroft; Councillor Colonel S. P. Dawson, O.B.E., M.M., T.D.; Sir Kenneth D. Stewart, K.B.E.; Sir Christopher T. Needham, D.L.; Alderman Sir William Kay (Deputy Chairman); Mr. Alfred Watkin; Alderman E. J. Hart; Alderman G. H. White; Alderman Sir Miles E. Mitchell; Alderman R. W. Shepherd; Alderman Samuel Woollam; Alderman W. T. Jackson; Alderman Joseph Binns; Mr. T. A. Guest (Mechanical Engineer); Mr. F. B. Greenwood (Chief Engineer); Mr. M. Kissane (Secretary); Sir Frederick J. West, K.B.E. (Chairman); Mr. Leslie Roberts, C.B.E. (General Manager); Mr. K. R. Brady (Assistant General Manager); Mr. G. A. Howe, A.C.A. (Accountant) and Alderman James.

The Board Room is a capacious chamber 42-ft. long by 23-ft. wide. There is a recessed space, 10-ft. by 4-ft. 6-ins. fitted with rollers for eight maps, which can be separately displayed and lighted by reflectors. The ceiling is heavily coffered, having nine panels, each lighted by 8 pendants with cut crystal bowls. The centre pendant bears six lights.

The elliptical Board table is 24-ft. long by 12-ft. wide. The outer rim is morocco-leather covered, and the inner filling, polished mahogany with inlaid border in boxwood and ebony.

A record of chairmen from 1885 to 1933 in cast bronze lettering occupies a large panel at the end of the room. The names are as follows:

Daniel Adamson	1885—1887
Lord Egerton of Tatton	1887—1894
John K. Bythell	1894—1916
William C. Bacon	1916—1931
Alfred Watkin	1931—1933
Sir Frederick J. West, K.B.E. ...	1933—

In front of the panel is a white marble bust of Mr. Daniel Adamson, the first Chairman of the Company.

The following notes on Ship Canal House in King Street, Manchester, are taken from *The Architect and Building News*, of July 8th, 1927.

The building has nine storeys in addition to the basement, the topmost two storeys being set back from the main frontages. The principal elevation, as seen from King Street, scarcely shows this attic at all, and all that is visible of it is the top of the parapet, which acts as a satisfactory background to the group of statuary surrounding the central portion of the collonade. This latter comprises seven bays divided by coupled Roman Doric columns

Board Room of Manchester Ship Canal Company
(continued)

and forms, with its entablature, a fine crowning feature. The building is of entirely fireproof construction, the walls up to the ground floor level being ferro-concrete. Above this level, the

Ship Canal House.

main elevations are in Portland stone, and the elevations to the areas in terra-cotta. The main entrance doors are in bronze; the hall is in marble, while the staircase is of marble terrazzo, with tiled walls and bronze balustrade.

The architect of the building was Mr. Harry S. Fairhurst, F.R.I.B.A.

The Timber Trade of the Port of London

By J. L. BAYNES,
President of the Timber Trades Federation of the United Kingdom.*

The Timber Trade normally is almost wholly an import trade, but in war-time very large quantities of timber are produced from our home forests. By sacrificing these we have reduced imports to a minimum, but this condition cannot continue for any length of time, and to meet our normal needs the timber import must be resumed.

The trade falls roughly into four parts: Softwood, Hardwood, Plywood and Veneers and Pitwood. Of softwoods, the largest part are used in building, case-making, railway sleepers, telegraph poles, and so on. The chief sources of supply are Canada, Finland, Russia and Sweden. The Canadian timber trade has in recent years overtaken that of Finland, Russia and Sweden, previously the chief source of our imports, largely as a result of the 10% imperial preference given to British Dominions at the Ottawa Conference. During the war, we have relied heavily upon Canada's timber supplies, and we will not forget what she has done.

Hardwoods come from U.S.A., British Honduras, Nicaragua, Costa Rica, West Africa, Burma, Japan, and many other countries, and are used principally for furniture, ship-building, shop fittings, and high-class panelling.

Plywood comes from Russia, Scandinavia, Canada and the U.S.A. Every year it finds fresh markets as science reveals new uses. The future of Plywood is extremely bright. While the development of English manufacture of Plywood and Veneers promises to create what is almost a new industry here, it will have to rely upon imports for its raw materials.

Pitwood comes from Russia and the Scandinavian countries, and is used in coal-mines. It is not imported into London.

There is little re-export of wood goods, although a little goes out for important contracts abroad and for use of our Crown Colonies.

Twenty-five per cent of the Softwoods imported are used for boxes and packing cases, and many of these are used in the export trade. Wood is the essential commodity for the efficient packing of our export products. Purchasing is usually done through London agents representing the producing shippers. These Timber agents, like so many other London commodity agents, sell large quantities of wood which never touches these shores. Most of the Dominions and some foreign countries use London agents for their wood purchases.

In pre-war years the timber import was second in importance of all import trades, with an annual volume of over ten million tons, with a value of £53,000,000. £34,000,000 represented Softwoods; £9,000,000 was for Hardwoods; and £5,000,000 each for Plywood/Veneers and Pitwood. These figures give some idea of the importance of the trade to the country.

London's timber import on average between 1936 and 1938 amounted to three million tons with a value of £18,500,000. One-third of the timber import for the whole country comes to the Port of London. Two-thirds of the total Hardwood and Plywood imports flow through our Port. In the last full year before the war, 792 vessels came into the Port of London with full cargoes of timber, and very many more had part cargoes. Usually, one-third of a normal timber cargo is carried on deck, towering as much as 12 to 15 feet above it. The boats usually employed range from 1,000-3,000 tons nett register, as larger boats are unsuitable for the loading ports in Scandinavia and Russia. Boats in the Canadian trade are much larger, and the 10,000-ton boats now being built in the U.S.A. will be a useful addition to the transatlantic timber trade fleet.

In pre-war days, only 21% of the timber import was shipped in British vessels, chiefly because they are too big for the trade. The timber trade would gladly respond to any effort which British shipowners might make to secure a larger share of the business. I hope British owners will consider whether it is not worth while to make a bid for this large business by providing suitable boats.

Three-fourths of London's timber import is delivered overside into lighters and goes to private yards and sawmills in the Port for storage, or to towns and villages within the range of transport from London. Thus towns in the Home Counties, and further away, employ large numbers of men in the lighterage and transport of their goods.

The Port of London Authority stores about a quarter. Softwoods are stored almost entirely at the Surrey Commercial Docks, only 2½ miles from London Bridge where the P.L.A. has 103 acres of land and 51 acres of water storage. These docks have been the hub of the London timber industry for nearly 150 years, and the extensions of facilities have been unable to keep pace with the constant expansion of the trade. The Softwood trade is largely seasonal, as a result of the icing of the ports of origin, and the Port of London will have to supply increased facilities to cope with the flood of vessels in the Summer and Autumn if it is to regain its reputation for the speedy discharge of vessels.

*Address delivered at meeting of London Liberal Party at Grosvenor House on 24th November, 1943.

Timber Trade of the Port of London—continued

The human element involved in London's timber import is hard to estimate, but at least 20,000 workers are employed in the London area in sawmilling and discharging and handling the wood, quite apart from those who earn their livings by it after it leaves the merchant's yards. The formation of the National Dock Labour Corporation is welcome as providing some security for dock workers. At the same time the surcharge levied to provide for men for whom there is no work adds a heavy item to the cost of discharging vessels in the Port, but I have no doubt that with the goodwill of the men and their Unions it will be possible to keep the Port of London to the fore and at the same time deal justly and fairly with the workers upon whom the Port relies.

The timber trade is closely interested in re-afforestation and hopes the Government will have learned the lesson of the last post-war period, and not treat the Forestry Commission as the Cinderella of the Departments. German industry depends on wood to an astonishing degree, for she uses it to power road transport, for the production of synthetic rubber, to clothe her people and even to feed her cattle.

In this country both the Rayon trade and the Paper trade rely on wood pulp as their raw material, and a great expansion in the volume of imports is certain. A sound re-afforestation scheme is essential. It has been said that when the 1914 war started we had 400 known uses for wood. When this war started there were 4,000. By its end there may be ten times more. Timber will be wanted in vast quantities in the period of reconstruction. There is no shortage of wood in exporting countries and it is our duty to see that this wood is brought in at the earliest possible moment. While the price structure remains dislocated by the huge demand, some continuing measure of Government control will be necessary. The timber trade is anxious to regain as soon as possible the life-giving atmosphere of private enterprise and free competition, but it recognises that while demand is greatly in excess of supply, prices and profit should be strictly controlled, and will be content with a reasonable remuneration for its efforts.

Legal Notes

Defective Berth: Insufficient Warning

The following judgment was delivered by **Mr. Justice Pilcher** in the Admiralty Division on January 13th, 1944, in connection with a claim by H. A. Deering Lighterage, Ltd., owners of the dumb barge *Humorist* against J. and W. Nicholson & Co., Ltd., wharfingers, owners of Nicholson's Wharf, Bromley-by-Bow, London, E., for damage sustained by the barge in question at the defendants' wharf. The Report is extracted from *Lloyd's List* of January 14th, 1944:—

Mr. Justice Pilcher, in his judgment, said the defendants had a wharf and premises in Bow Creek, and the berth was level concrete, not dry at low water but covered by mud and slurry. An inspection after the accident produced from it two 7 lb. weights and two 2 lb. weights and a later inspection, three more 2 lb. weights. One of the 7 lb. weights coincided with the serious bottom damage in the *Humorist*. The fact that one of the weights contained sea lice suggested to the plaintiffs that it had been lying there a considerable time. The weights were of prismatic shape with rings through the eyes. The invitors were subject to the ordinary obligation to exercise reasonable care to have the berth safe for the reception of the *Humorist*, or, if they did not exercise reasonable care, to give warning to the invitee. A bomb caused material to fall on the berth, but after that incident a few barges were lying on the berth between October, 1941, and February, 1942.

Early in March, 1943, the defendants determined to put their berth into use again, and their men were directed to make it ready for the reception of craft. They went over the berth with linked arms and feet spread out, looking for obstructions in the manner sometimes adopted by golfers in looking for a lost ball in the long grass. There was a drop from the berth into the creek and they took squeegees and cleared off the last 2-ft., pushing the slurry into the creek. For the defence it was said they performed a further operation, when three of the men went over the whole berth with squeegees.

The Court had been asked to draw the conclusion that between the inspection on March 12th and March 27th, when the *Humorist* arrived on the berth, the weights could have been flung on the concrete by disaffected workmen whom the defndants had dismissed. The barge owners asked the Court to find that the second act of cleansing was not performed and that the first was not enough; operation No. 2 was a desirable precaution to take on a concrete berth which had not been used for several years. Originally one operation alone, on March 12th, was spoken of, and his Lordship was not satisfied the second operation ever took place.

In May, when the defendants' engineer enquired what had been done, he was told of both operations for the first time. It was clear from the report of Mr. H. D. C. Rogers, the surveyor for the barge owners, that it was not suggested to him that two operations had been performed. The pleadings said only that "on or about March 12th, 1943, the defendants, by their servants, made a thorough and careful inspection of the berth, and the berth was then free from obstruction."

"I am not satisfied," his Lordship went on, "that operation No. 2 was ever performed, and I cannot accept the evidence of the witnesses that they performed it on this particular occasion. I do not think that the treading over the berth spoken to was a sufficient preparation of the berth for the reception of craft. Walking, as they were, in water, slurry and mud, the men might well have failed to find the weights that did the damage. The defendants had not exercised proper care in the preparation of the berths for the reception of the *Humorist*.

The Warning Notice

Mr. Justice Pilcher recalled that three barges had lain at the berth between March 12th and March 25th. Two had loaded barley, as the *Humorist* had done, and one had discharged barley. Two must have lain, he said, on the berth through low water. He had found that the berth was not "cleaned off" on March 12th. The depth of mud might have been greater when the *Humorist* was there, and the fact that weights were embedded in the hard mud showed that they had been embedded there for a considerable period. The defendants contended that, if they had failed to exercise due care, they were absolved from liability by the following notice they hung on the wall of their premises 25-ft. from the ground:—

NOTICE TO BARGE-OWNERS AND OTHERS.

"Messrs. Nicholson & Co., Ltd., hereby give notice that they do not represent that the bed of the river adjoining their premises is safe for vessels and barges passing thereover or resorting to their premises; nor shall they be deemed to warrant that such bed or the berths for the vessels and barges adjoining or being part of their premises or the approaches to them are in an ordinary condition of safety for vessels or barges coming to or lying at their wharf or wharves.

"All vessels and barges coming to or passing over their premises or the river bed adjoining thereto will do so at the risk of their respective owners or charterers.

"The acceptance (printed 'exceptance') of the terms of this notice is a condition upon which alone vessels or barges will be permitted to resort to come to their property or pass over the same.

"The said J. & W. Nicholson & Co., Ltd., hereby forbid the mooring of vessels or barges upon or near to their property.

"Dated this 1st day of November, 1899. J. F. Hunnard, Secretary to the said J. & W. Nicholson & Co., Ltd."

Mr. Scott Cairns had submitted that this notice constituted a modification of the general terms of invitation to the plaintiffs. The notice board was brought into Court. Since this accident it had been cleaned up and was more legible than at the material date. The man on the barge said he could not read it, where it was, when standing just underneath it. A surveyor and others tested it, and Mr. Rogers, for the plaintiffs, took three minutes

Legal Notes—continued

to read it and made three mistakes. Mr. Ellison, the barge foreman, who had very good eyesight, read it in two-and-a-half minutes with two stops. His Lordship was satisfied that on March 27th the notice board must have been extremely difficult to read. The lighterman, he thought, was a good type of man and was an ordinarily observant lighterman. He did not see the board until his attention was directed to it, and from the position in which the *Humorist* lay it would have been difficult for a man with ordinary eyesight to decipher the notice. No doubt the headline could be read, but his Lordship was not satisfied that the notice could be read by a lighterman approaching the wharf.

The Court did not think the defendants took reasonable steps to bring the conditions to the notice of casual invitees. He did not think these invitees could be affected by notice of a modification of the ordinary terms to invitees or to have been specially warned by the wharfingers. Accordingly the barge owners succeeded in their action and were entitled to judgment against the defendants. The matter would be referred to the Registrar and merchants to assess the amount of damage. The plaintiffs, having succeeded on the issue of liability, were entitled to their costs on the High Court scale. Having regard to the length of time the case took and also to the question of liability under the notice, this was a proper case to bring in the High Court.

Correspondence

To the Editor of "The Dock and Harbour Authority."

Electric versus Hydraulic Quay Cranes.

Dear Sir,—Regarding Mr. Nicholson's letter of December 4th 1943, which appears in the correspondence columns of your issue for January this year, I would like to mention that the effect of the load on the hook is of little importance to the available acceleration. If the latter is expressed as "a" feet per second, per second, the fraction a/g, where "g" is the acceleration due to gravity, is the effort required to accelerate the load in addition to that needed to hoist it at constant speed.

To attain 240 f.p.m. in 2 seconds as cited for the hydraulic crane, therefore, only 6.2% additional effort is required to accelerate the load.

In the case of the electric drive there is no reason why it should not reach the same standard, unless there are unfavourable peculiarities in the equipment of the 3-ton crane, which Mr. Nicholson has tested. If it is assumed that the hoisting motor is operating at rated load with 3-tons, (65 h.p. or 70 h.p. motor probably) then 6% extra is required for accelerating the load and perhaps 50% for the gearing, brake pulley and rotor, the last two items being the only real store of kinetic energy on the job. The total requirement during starting the electric drive at 2 fpsps is only 160% of full load when hoisting, and slightly less for lowering.

Crane motors should be capable of developing 200% to 250% full load torque, even if they are of alternating current type, and in this connection the d.c. series motor is the best performer, the a.c. slipring runs second whilst the a.c. commutator motor is a very poor third, bearing in mind that the important factor is the relation between the maximum torque and the Wr^2 and speed of the rotor. The rated torque brings the series and slipring motors up to speed in under a second.

For creeping speed hydraulic cranes give superb control, but modern systems of electric control can fulfil all requirements, and it is possible to improve considerably upon the 30% mentioned in Mr. Nicholson's letter, if special creeping facilities are required.

The writer has never encountered any difficulty in attaining sufficient acceleration on electric hoists and it would be interesting to hear if there is an explanation of the very unfavourable test figures provided in your correspondent's letter.

Yours faithfully,
RICHARD A. WEST
A.M.I.E.E.

Igranic Electric Co., Ltd.
Glasgow, C.2.
8th January, 1944.

To the Editor of "The Dock and Harbour Authority."

Electric versus Hydraulic Quay Cranes.

Dear Sir,—There is something obviously radically wrong with Mr. Nicholson's tests per his letter in your January issue; the electric results in especial are extraordinarily in diversity with technical facts which cannot be in dispute. There is little or no information to enable an opinion to be formed as to where the error lies. One would like to know, (1) the method of the tests and in especial how it was ascertained that full speed had been attained, (2) the type of current used on the electric crane, and (3) the type of its motors.

With regard to (2) and (3) presumably the crane was not A.C. with a squirrel cage rotor lifting motor; if it were so the test would be of no value as such motors are, as indicated in my article, very bad starters and unsuitable for crane work.

If on the contrary it was D.C. with a series motor or A.C. with a wound slip ring rotor motor Mr. Nicholson had at his disposal starting torque and accelerating power 14 times at least in excess of what he used. Presumably this arose from bad handling of the controller or over-slow setting of automatic timing gear but if so the result should not be put down as that of a representative test.

The accelerations recorded are respectively 2-ft. and .57-ft. per sec. per sec. comparing for example with traction rates of 1.5 to 4.5-ft. per sec. per sec. Some additional kinetic energy beyond that imparted to the rising load is absorbed by the moving parts of both cranes and the column of pressure water of the hydraulic one.

Neglecting this as being incalculable without further data and taking the efficiency as the same as that for lifting, the powers required for acceleration are respectively 1/16th and 1/56th of the full load lifting power. This latter power is much higher relatively to the accelerating power than in the case of traction because of its being against the dead lift; in traction parlance the gradient is 100 per cent which makes the power available for acceleration as a percentage of the lifting power all the greater and Mr. Nicholson's test result all the more inexplicable.

On the other hand in the slewing luffing and travelling motions power for acceleration is predominant.

Briefly what Mr. Nicholson's test result suggests is that he cannot get more than about 2 per cent. over full load lifting power out of a motor rated for 25 per cent. overload and capable, if it is a normal machine of sound construction, of probably up to 100 per cent. overload.

Creeping speeds are purely a matter of the type of crane and of the type and setting of the control gear. On a D.C. crane practically any creeping speed can be given, if specified, and in this connection Mr. Russell Taylor's letter also in your issue of January might be referred to. To a less extent this applies to A.C. wound rotor cranes. I am not aware of any method of obtaining creeping speeds on A.C. squirrel cage rotor cranes. My experience of electric cranes and electrical machinery generally is that breakdowns are infrequent once the plant has settled down and the maintenance staff are accustomed to it. It could be expected and is frequently argued theoretically that additional working parts necessarily involve increased maintenance but this has not been my actual experience; naturally much depends on the nature of the parts and the duty they do. Humidity and pollution mainly affect surface insulation and if surfaces are smooth, are kept clean, and are of adequate length there should be very little trouble of this kind. Incidentally, I know of many electric machines, and cranes among them, which have worked 30 to 40 years without substantial breakdown.

Mr. Nicholson is to be congratulated on his comparative immunity from frost failures on his hydraulic machinery, but I take it his drainage and heating arrangements cost money. His immunity is not I think shared universally.

As regards the installation of further electric cranes being a matter of expediency rather than of choice, I know of no cases where hydraulic cranes have been substituted for electric but there are numerous cases of the reverse.

Yours faithfully,
J. DALZIEL.

Chorleywood,
Rickmansworth, Herts.
8th January, 1944.

Notes of the Month

Death of Former Dock Engineer.

The death has taken place at Holtye, Sussex, of Mr. George Ernest Pengelley, who was formerly for several years, resident engineer at the Surrey Commercial Docks in the service of the Port of London Authority.

Death of Former Dry Docks Official.

The death has occured at the age of 73, of Mr. William Francis Hunt, who, eight years ago, retired from the position of works manager of the Merchantile Dry Dock Co., Ltd., Jarrow-on-Tyne.

Sydney's New Graving Dock.

The Australian Minister of the Interior, (Mr. J. S. Collings) has announced that the constructional cost of the great new graving dock at Sydney, originally estimated in 1940 at £2,997,000, is now likely to be increased to £6,750,000.

Death of Former Harbour Master.

Mr. Alexander M'Crindle, who died recently at Girvan, aged 70, was for sixteen years harbourmaster at that port. He was born there and served in the Merchant Navy throughout the last war. He had been retired from the harbour service for some years and was latterly employed on wartime work by the Board of Trade.

Port of Sunderland Welfare Committee.

A Port Welfare Committee has been formed at Sunderland to co-operate with the Ministry of Labour and the Seamen's Welfare Bureau. Mr. P. W. Ayton, local secretary of the National Union of Seamen, has been elected chairman and Mr. Thomas Rose, a representative of the ship-owners, vice-chairman. A sub-committee has been appointed to examine the question of establishing a hostel at the port for merchant seamen.

Mersey Docks and Harbour Board.

At a meeting of the Mersey Docks and Harbour Board held on 22nd December, 1943, Sir Thomas A. L. Brocklebank was re-elected Chairman of the Board and Mr. Edmund Gardner, Vice-chairman. The Board's representative on the Upper Mersey Navigation Commission, Mr. Tom Stone, was reappointed for a further period of 3 years, from 1st January, 1944. It was also announced that the Ministry of War Transport had reappointed Mr. Stone a nominee member of the Board.

New Laying-up Basin at Port of Gothenburg.

For the purpose of accommodating newly constructed large motorships, a special laying-up harbour basin is being provided at the port of Gothenburg, Sweden. It is located between Gotaverken and the Free Harbour and has a length of 250 metres, a width of 200 metres and a depth of 7 metres. It will be able to accommodate six vessels of about 15,000 tons each and three vessels of 5,000 tons. No actual quay work is being executed, as no loading or discharging operations are to be carried on in the basin. The cost of the work is estimated at 435,000 kr.

Obituary.

Although not directly associated in his lifetime with port administration, the passing of **Sir Norman Hill** calls for mention in this Journal on account of his weighty influence in matters of port policy. For 30 years he was secretary of the Liverpool Steam Ship Owners' Association and, a lawyer by profession, he acquired a wide reputation as an authority on shipping questions. Perhaps one of his notable achievements was the successful result of the campaign which led to the passing of the Merchant Act of 1906. The Act established a new basis by which the Board of Trade had discretion to relax certain of its statutory requirements under suitable conditions and provided for the setting up of the Merchant Shipping Advisory Committee, of which Sir Norman was chairman from 1907 to 1937. Sir Norman had attained the advanced age of 80.

Newcastle Trinity House.

Captain Henry How has been elected Master, and Captain J. G. Hardy, deputy-master of Trinity House, Newcastle.

Retirement and Death of Dry Dock Manager.

Mr. Richard G. Elliott has died almost immediately after retirement from the position of manager of the dry dock department of Messrs Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne. He has been succeeded by Mr. Ernest John Hunter, a director of the firm and grandson of the late Sir G. B. Hunter.

Sea-Airport at Lisbon.

At a cost of half-a-million sterling the sea-airport at the port of Lisbon is to be moved two miles up the river Tagus, to a more suitable position. A new dock is to be provided which will afford anchorage for four or five aircraft with ample space for manœuvring. A modern road will connect the sea-airport with the land airport at Portela, opened last year.

New Year Honours in Port Circles.

In the New Year Honours List, knighthoods are announced for Mr. Ronald Thornbury Garrett, the chairman of the National Dock Labour Corporation, Ltd., and for Mr. William Thomson Halcrow, who has been so prominently associated (among other engineering undertakings) with the development of the Port of Beira, Portuguese East Africa, articles on which have appeared in this Journal.

Fife Harbour Complaint.

A complaint that the water in the West Wemyss Harbour was stagnant and causing a nuisance was made by Councillor J. Hope, at a recent meeting of Wemyss District Council. The officials have been asked to investigate this matter. West Wemyss was formerly used as a shipping port for sailing vessels engaged in the Continental, Scandinavian and Russian trades in coal, previous to the construction of Methil Docks, and, like Dysart Harbour, a mile away, suffered complete eclipse when steam ousted sail, and coal exports were confined to the Methil Docks.

New Entrance Channel to Swedish Port.

A new entrance channel to the port of Uddevalla, on the west coast of Sweden, has been in commission since early in October, and will be of considerable service to the port, as it provides a shorter route to the sea. The channel has a depth of 8.8 metres and allows of the passage of vessels drawing eight metres of water. The work of widening and deepening the channel, which was carried out by the Swedish Government, largely as a means for relieving unemployment, has involved the removal of 257,000 cu. metres of material by dredging and 119,000 cu. metres of rock by blasting, at a total cost of about 4 million kroner.

Dockside Thefts at Liverpool.

At Liverpool Sessions in January, it was stated by Police Inspector Culshaw that dock thieving is still extensively practised. The officer affirmed: " It is as bad as ever and the trouble is that the goods stolen are for export, with the result that the thefts are not disclosed until the ship has reached her destination and the cargo is being discharged."

Sentencing Thomas Eric Carearo, 20, fitter, to 12 months' imprisonment with hard labour, for receiving a jersey and other articles, the property of the Mersey Docks and Harbour Board, knowing them to have been stolen, the Recorder, Mr. E. G. Hemmerde, K.C., said that but for his excellent character accused would have received a much more severe sentence.

The Recorder said to Carearo: "At a time when this country is fighting the most important war in history, you, a well paid man, let your country down by receiving goods stolen from our Allies. I can assure you and others that there are going to be no nominal sentences for this sort of crime in Liverpool as long as I am sitting here."

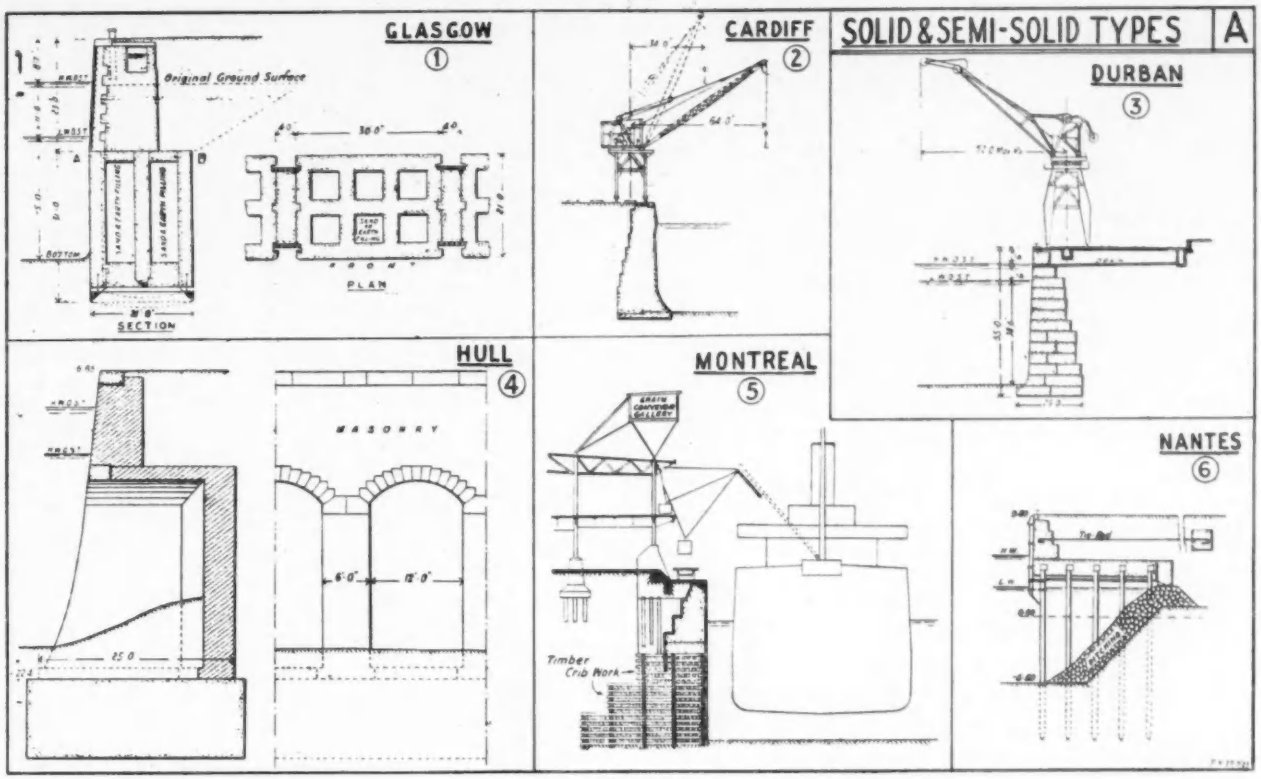


PLATE A.

*Notes on Dock Wall Design and Construction**

By ROBERT DUNLOP BROWN, M.Inst.C.E.

I. The Problem.

LOOKING at dock walls from the outside they all appear to be alike; but when we inquire into their internal structure an astonishing variety is discovered. Why is this? Why is it, that except in some common details, they have not been more or less standardised, like most other engineering structures?

The main reason for this diversity is that, apart from the individual idiosyncracies of the designer, no two sites are alike. The strata may vary from rock of all kinds down to soft fluid mud. The depth at which the wall is founded may vary; also the thickness and the sequence of the strata. The plant and materials available for construction may differ between one site and another, and even the labour available may vary.

These factors have to be considered in solving the problem of design, and their variety explains the very wide variations to be found in dock wall designs throughout the world. The best design is the one which best meets all the conditions at the site, and, in particular, pays regard to the constructional difficulties of the work.

From the mass masonry of the older types to the thin panels of the more recent relief-platform type, a wide choice is possible; solid, semi-solid, rectangular, circular, trefoil, sheet piled, stool piled, and so on—and how do we arrive at the best design?

It seldom happens that the first design prepared for any site, is the best design. Usually, it is necessary to prepare a number of alternative designs and then, having abstracted the quantities and priced them, and having considered the matter from all angles, to select the best.

It is a lengthy process, requiring considerable labour and patience, but the author knows of no other way; no short cut.

It may help us perhaps if we consider these things in a little more detail.

First of all let us get quite clear in our minds just what we have to do.

We have to design a wall whose most simple functions are (1) to provide sufficient water for the ship to come alongside, and (2) to have a deck strong enough to carry cargo and cargo handling appliances—cranes, locos, etc. The wall must not slide forward. It must not tilt off plumb in any direction. It must not "settle" on its foundations except perhaps to a very small extent, as it finds its bearings, and this small settlement must be uniform. Expansion and contraction due to temperature changes must be provided for. The considerable amount of contraction which occurs during the setting of new concrete during construction must not be forgotten. The wall must be able to withstand the heavy accidental impact of a ship colliding with it, and in such a case must not show more than merely local damage to the fenders provided for that purpose. Similarly it must withstand, through the wire ropes attached to its bollards, the pull of a ship swinging out of control. These ropes have been known to carry a pull of 120-tons before breaking. Finally, the matter of maintenance must be kept in mind so that the annual cost may be kept to a minimum. In time of war, speed of construction must over-ride every other consideration, and factors of safety may have to be reduced almost to vanishing point.

These then, are the requirements which a dock wall has to meet. The wall which meets them successfully must resist the overturning pressure of the back fill at the same time as it is upheld in equilibrium by the support of the foundations.

*A short Paper presented under the auspices of the Panel of Lectures appointed by the Council of the Institution of Civil Engineers with the intention of bringing Student Civil Engineers at Universities and Technical Colleges into closer contact with current practice. Reproduced by permission.

Notes on Dock Wall Design and Construction—continued

When faced with any problem in design such as this, it is but natural to inquire—what has been done before in similar circumstances? How have other men solved the problem? Can their solution be improved upon?

Many hours are spent in searching the Institution Minutes and other sources for examples and "precedents," and there is much to be said for this practice. One of the dangers of studying precedent too much, is, that freshness and originality are apt to be lost in the process. The mind must be brought fresh to each problem without bias towards any previous solution of a similar problem. It is always interesting to see how other men have solved their problems, but the final solution we are seeking must be the only one which best fits all the conditions at the particular site.

II. Existing Walls.

Having in our minds the conditions under which the wall is to be designed and built, let us look at some existing walls. Plates "A" and "B" show a dozen examples of existing walls selected from hundreds of places throughout the world. Many more might have been produced; all different.

Perhaps the first lesson to be drawn from this diversity is, that site and constructional conditions dictate the design in every case. Compare Glasgow (A—1) with Montreal (A—5).

At Montreal timber was easily available, and the great bulk of the wall was built of timber crib work, which was sunk in place and filled with stones. At Glasgow, note the difference; the only timber used was in the shoe which formed the cutting edge for the monoliths. Concrete was used as sparingly as possible. The original ground was excavated down to the line A—B; just to the level where water begins to be troublesome. The shoe was placed in position, and the monolith blocks built on top of it, in proper bond. The excavation was taken out from inside the six holes left for that purpose, and the monolith sank by its own weight, sometimes assisted by kentledge. When a suitable foundation level was reached, the holes were filled with earth and sand and thereafter an ordinary mass concrete retaining wall completed the structure. Afterwards the earth in front of the wall was removed, mostly by dredging, down to dock bottom, and the back fill was placed in position.

It will be noted that each wall, in design and construction, is or should be suitable for the conditions at that particular site, and for no other site.

In the case of the Hull dock wall (A—4) much material had to be sacrificed in obtaining the great depth and spread required for the foundation slab. Some attempt, therefore, had to be made to save material in the wall proper. The wall is, accordingly, to a large extent, made hollow. It should be noted that although the dead weight is thereby lessened, the earth pressure behind the wall is not reduced in any way.

It may be of interest to note in passing that the walls of No. 9 Dock, Manchester, which were built in 1904, are very similar to those at Hull, built about the same time.

At Nantes (A—6) we find a considerable departure from the all-solid type of wall. Here the designer has ventured away from the older solid types, and uses what may be called a semi-solid arrangement; a miniature mass concrete superstructure is carried on concrete piles.

For the first time we notice the introduction of the land tie.

On the remaining examples of existing dock walls (the counterfort types shown on plate "B"), there is only space for brief comment. In these walls mass concrete has disappeared, except for a small vestige at Amsterdam (B—2). In the counterfort generally, the use of material is cut down to the barest minimum, and in every case stability depends, either upon a land tie, or upon a counterfort which anchors the wall to a sunken relief-platform loaded with back fill. In each case the design no doubt fulfilled the requirements as regards the strata and was also suited to the labour, plant and materials available at the site.

III. Examples of Failure.

There is an old saying used by sailors "Let another man's shipwreck be your land mark." On plate "C" three examples of recorded dock wall failures have been reproduced and these will repay study.

When the back fill was being placed behind the newly built wall at the Empress Dock, Southampton, plate (C—1), it suddenly

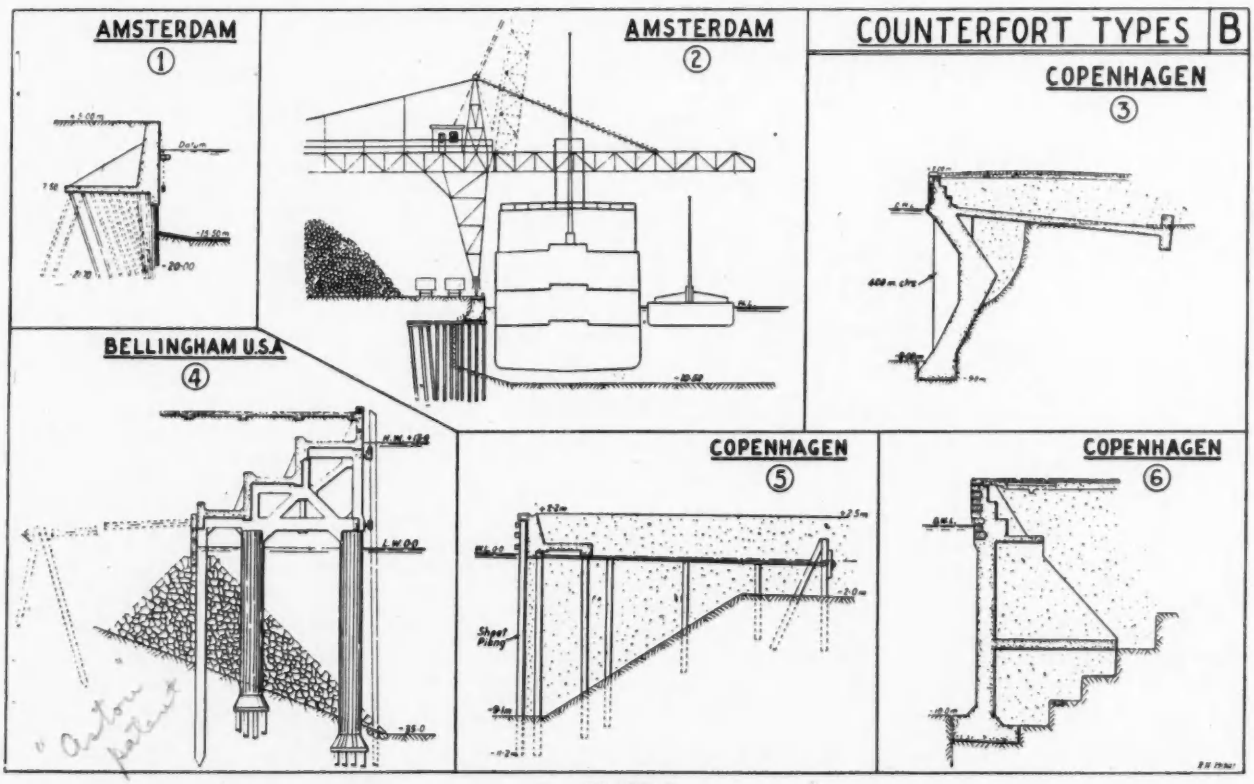


PLATE B.

Notes on Dock Wall Design and Construction—continued

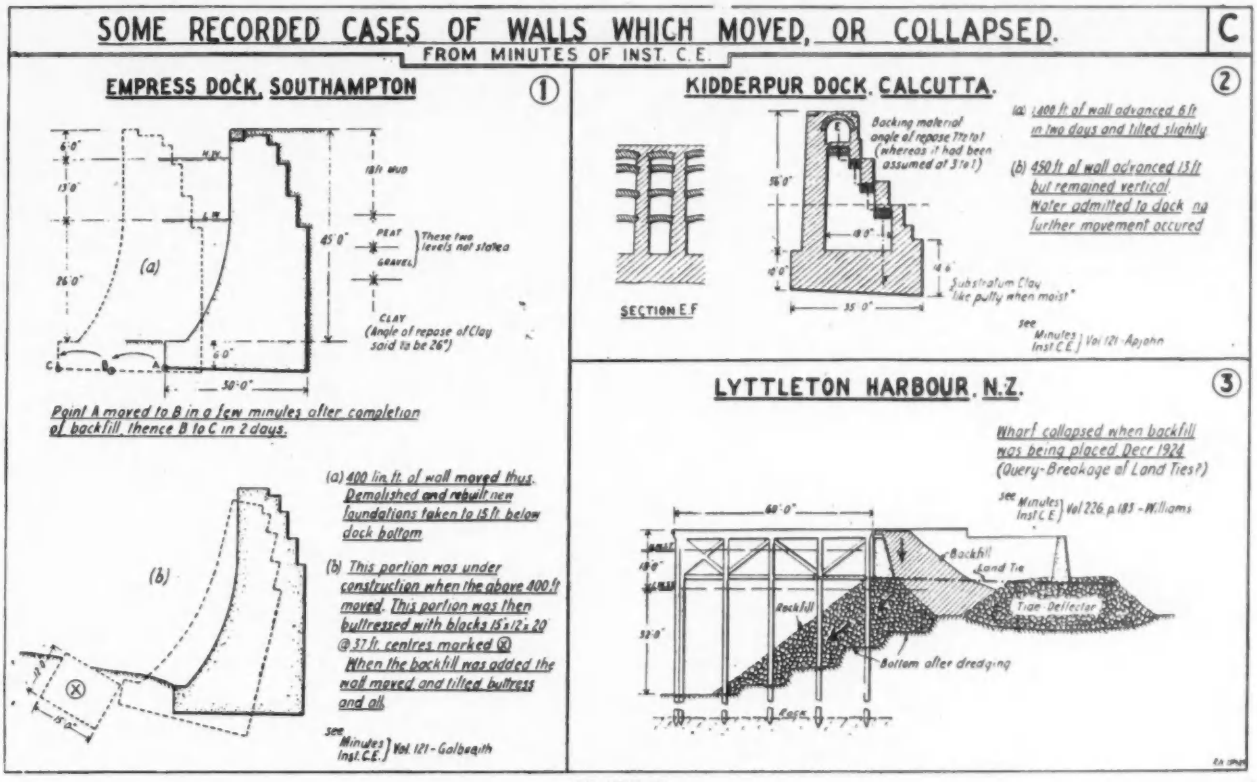


PLATE C.

moved forward on a length of 400-ft. In a matter of minutes, the toe had moved about 10-ft. Its movement then slowed up and in two days it had moved another 10-ft. Fortunately it still remained vertical. This portion of the wall was taken down and rebuilt upon foundations carried down 15-ft. below dock bottom (instead of the original 6-ft.).

While this was going on, another portion of the wall, which had not yet been back filled, was still standing. It was thought that in view of the behaviour of the first 400-ft. length, some obstruction should be placed in the way of any sliding movement, and blocks 20-ft. long, 15-ft. wide by 12-ft. deep were built in front of the toe. But when the back fill was added the struggle began. The wall began to slide forward and then to tilt backwards, pushing the huge buttress blocks in front of it, and raising the dock bottom into a mound. The wall finally came to rest as shown in the bottom sketch on plate (C—1). No doubt it would be possible to work out mathematically, or perhaps by graphic statics the forces which held the wall for a time in that queer state of unstable equilibrium. We might learn more from that than the study of a successful wall—which might be just too strong altogether. It is only intended here to call attention to the considerable magnitude of the unseen, and often forgotten force, which the earth pressure exerts unceasingly upon the back of the wall, and in this case was strong enough to push in front of it, first, the wall, and then (2) the heavy buttresses, and finally (3) the solid clay at the dock bottom.

The next example (C—2) is of hollow type wall at Calcutta of which a portion, 1,400 linear feet long, moved forward 6-ft. and tilted slightly, while another portion 450-ft. long moved forward 13-ft. but remained vertical. Here again the earth pressure on the back of the wall was too much for it. The original cause of the failure appears to have been insufficient knowledge of the conditions at the site. The backing material was assumed in the design to have an angle of repose of 3 to 1 whereas in construction it was found to have a spread of 7½ to 1. It must indeed have been very poor back fill.

The point here, as in the Southampton case—and this must be emphasised—is, simply, that the pressure on the back of the wall was too much for the forces resisting that pressure. The wall was not in stable equilibrium. It could only slide forward. Fortunately, in the Calcutta case, the admission of water to the dock was sufficient to arrest the sliding, and restore some sort of stability. Nothing more had to be done, whereas at Southampton, a long length of wall had to be taken down and rebuilt.

It must also be emphasised that in both these cases the walls were founded on clay.

We now come to the failure of a different type of wall—a piled structure at Lyttleton Harbour, New Zealand (C—3) which was held in place by means of a land tie. The collapse occurred when the back fill was being placed, and the actual cause of the collapse will probably never be known. Several questions might be asked but let us content ourselves with two. (1) Did the land tie sag and break under the weight of the back fill? or, (2) Did the stool piles bend and break under the side thrust of the rock fill?

Perhaps both these things happened in sequence or simultaneously, and the student to whom these notes are addressed will do well to consider these matters carefully. If the tie failed, then it was not properly designed; if the piles failed under the side thrust of the rock fill then two things ought to have been done, (a) the piles ought to have been strengthened in the thwartship direction and (b) the rock fill should have been placed, in such manner that no side pressure could bear upon the piles. It is difficult to see how this could have been done satisfactorily, and probably the only way would be to redesign this portion of the wall.

(To be continued)

Mobile Canteens for Port of London.

Three additional mobile canteens for use at the London docks have been presented by the British War Relief Society, to the Women's Legion, represented by Lady Londonderry, the president of the Legion. By this new gift, the number of mobile canteens given by the British War Relief Society has been increased to ten, some of which have been working in the docks area continuously for three years. Altogether, the fleet of mobile canteens operated by the Women's Legion now totals 25.

Mersey Docks and Harbour Board

Projected Improvements at Liverpool and Birkenhead Docks

Address by Chairman

At the meeting of the Mersey Docks and Harbour Board, on 22nd December, the chairman, Sir Thomas A. L. Brocklebank, Bart., gave the following address.

Work of the Reconstruction Committee

Members will remember that in July, 1942, I gave the Board a general outline of the work of the Reconstruction Committee up to that date. I feel now that the time has arrived when it is right for me to make a statement in public to give an indication of what we consider is the right policy to be adopted as regards post-war reconstruction and improvements of the facilities of the Port.

There has been considerable speculation in the press and elsewhere, with regard to schemes we might be considering for extending the Docks, both North of the present Gladstone system and on the other side of the river, by reclaiming the Tranmere foreshore or extending the Bidston Dock. Before considering any such schemes, it is obviously essential to form some sort of an estimate as to the extent of the future trade of the port, and whether we can expect such an increase on pre-war busy periods to justify the very large capital expenditure which would be required for such new works.

For security reasons, I can give no detailed figures, but I can tell you that since 1939 we have frequently handled monthly volumes of cargo greatly in excess of anything we did in normal times, and this under war-time conditions with all their attendant handicaps, including the black-out and damage by enemy action.

It seems to us, therefore, that it would be both improvident and unwise to contemplate at this time any large extensions or additions to the Dock Area, and that our proper policy is to do all in our power to improve the existing Docks by modernisation so as to be able to handle both ships and cargoes as cheaply and expeditiously as possible. For it is clear if under present conditions we can handle more ships and larger cargoes than pre-war, an intelligent policy of modernisation should give us a substantial margin in handling post-war traffic when all the other ports are doing their normal share of the country's trade.

Sir Thos. A. L. BROCKLEBANK, Bart.

Improvement of Existing Docks.

Accordingly, we are concentrating mainly on what can be done to improve our present Docks. During the last few months the General Manager has had interviews with representatives of most of the principal traders and shipowners using the Port, and also with the Director General of Civil Aviation so as to get their views on the types of shed, cranes, etc., most suitable for their various trades, both import and export. He has, as a member of Sir William Chamberlain's Committee, had every opportunity of studying the problems of Rail and Road access to the Port, and I am informed that considerable progress has been made. There have been meetings between our officials and the Railway Companies as a result of which a scheme has been prepared which should greatly improve the railway working to and from the Port.

We have, quite recently, received a deputation headed by the Mayor of Birkenhead, and including representatives of Wallasey. There is not a great deal of actual reconstruction work to be done in the Birkenhead Docks but considerable improvements can and should be made to certain sheds, and also to the Roadways, while we are all agreed that the freeing of the Mersey Tunnel from tolls would be of the greatest value to the Port as a whole and to Birkenhead in particular.

Proposed New Deep Water Entrance.

It has been obvious for a good many years that there was a real need for another deep water entrance to the North Docks. The present Canada and Langton Entrances have never been wholly satisfactory for handling the larger class of vessels, and owing to certain circumstances, the details of which I cannot disclose, it would be necessary to spend a very large sum of money to make them reasonably efficient, and even then we should not have got what we really need. We propose, therefore, to construct an entirely new Canada Deep Water Entrance. This will enable us to re-plan the Langton, Brocklebank and Canada Docks so as to provide new sheds with wide quay margins and the most up-to-date cranes and equipment.

We propose to construct two fine new sheds at North Huskisson No. 1 and South Huskisson No. 3 and a new Meat Berth with the best possible rail and road facilities, and at the same time it will be possible to provide additional railway sidings, thus fulfilling a long-felt want in Central Dock Area.

We would propose to proceed at the earliest possible moment with the completion of the New Waterloo River Entrance, work on which was suspended owing to the war.

Renewal of Dock Equipment.

In addition to these large and important new works, all of which ought to be able to proceed concurrently, there is a lot of equipment on the Dock Estate, much of which was getting nearly due for renewal prior to the war, which will now urgently require to be replaced owing to the strain of continuous work with a minimum of repairs. The major items are hydraulic pumping stations, impounding stations, roof cranes, coaling appliances and much of the Engineer's floating plant and the Coburg Dockyard.

I am satisfied that to carry out the programme I have outlined, will fully absorb the labour, material and finance likely to be available for at least three years after the termination of hostilities, and I could not recommend the Board to go in for any grandiose schemes of extension until this work has been done, by which time it may be possible to make a more accurate forecast of the likely volume of trade of the world in general and of this port in particular.

Seamen's Welfare at Ports.

The Government Committee instructed to enquire into the welfare work for merchant seamen at British ports, have recently made an inspection of hostels and other accommodation at Glasgow and in the River Clyde area. The duty of the Committee which has been set up by the Ministeries of Labour and National Service and of War Transport is to determine the respective parts that Government, industry and voluntary organisations are playing in seamen's welfare work and to ascertain what method can be adopted for controlling appeals for financial aid by voluntary organisations.

Subsqueous Dry Dock Construction

An Account of a Novel Method adopted in the United States for the Construction of Three Dry Docks of Outstanding Size

By DAN H. YOUNG, Local Manager, Dry Dock Associates, at Philadelphia

AT the instance of the Navy Department, Bureau of Yards and Docks, three contracting firms, Spencer, White & Prentis, Inc., Foley Brothers, Inc., and Merritt-Chapman & Scott Corp., were combined for convenience under the name of Drydock Associates and received contracts for the first three in the series of gargantuan new-type shipbuilding drydocks the United States Navy had scheduled for the national defence programme. Two of these three drydocks are located in the Philadelphia Navy Yard, and one at the Norfolk Navy Yard, Portsmouth, Va.

The docks, 1,100 feet long and 150 feet wide, will rank near the top of the list of the world's largest dry docks. The sill of the dock at Norfolk will be 45.7 feet below low water, and those at Philadelphia are to be 33.8 feet below low water. These docks will cost more than $10,000,000 each and are designed to accommodate the super-battleship of to-morrow.

In contrast with inclined shipways upon which all large battleships have heretofore been constructed and skidded into the water, with the attendant danger of breaking the ship in two at the launching due to poppet and way end pressures, the Navy's largest ships will be laid on an even keel in the future and floated off the keel blocks by flooding the new-type docks. The high overhead superstructures normal to large shipways will be eliminated, and a gantry spanning each dock and carrying two 75-ton hooks, will place the heavy loads involved in the construction of the ships. For lighter and shorter lifts there will be at Philadelphia, twelve 20-ton track gantry cranes and three 75-ton revolving cranes which will travel at the edge of the docks.

Mr. DAN. H. YOUNG.

We scheduled our operations to cut off a year-and-a-half from the time it ordinarily takes to build a dock, and we are now trying to squeeze a little more, for it looks as though we can anticipate our schedule. The remainder of this article describes the work at Philadelphia; the operation of the Norfolk job is different in some details, but is generally similar.

Commencement of Operations

The contract was awarded on June 26, 1940. The site was cleared and excavation started July 3. The 15-yd. dipper-dredge *Toledo* and the 7½-yd. clamshell-dredge *Camden* dredged out a basin extending about 900 feet back from the Delaware River's bank. The *Toledo*, in one 7-day period, excavated nearly 100,000 cu. yds. The dredged material was loaded into dump scows, towed across the river, and dumped near a suction dredge which in turn pumped the material to the Jersey shore, where it was used for reclaiming land.

The basin for Dock 4 was dredged to a depth of 53 feet below low water, 216 feet wide at the bottom and 436 feet in width at the top. As this is written, the dredging for Dock 5 is under way. It lies directly west of Dock 4, with 440 feet between centrelines of the two docks. The top of the slope between the docks will be a common one. The nature of the ground is such that the slopes stand at a ratio of 1 on 1¾, so that piling has not been required around the basin. . About 1,250,000 cu. yds. of spoil was removed for Dock 4.

After the dredging was completed, the next step was to cover the entire floor area with a minimum of 2 feet of crushed stone. The specifications for this stone required that it pass a 3-in. square and be retained on a 2-in. round, opening. A large drag made of I-beams was used to smooth the excavated floor and when the stone was placed it was levelled off by this drag. This operation of levelling the stone was necessary in order to produce a uniform seat for the steel tremie-concrete forms.

When the stone was graded, three pile-drivers were used in driving a total of 6,825 Bethlehem and Carnegie-Illinois steel H-piles. The upper ends of these piles are embedded 3 feet in the 14 feet thick concrete floor of the dock. Under the side walls the piles are designed for bearing, but in the centre their purpose is to prevent flotation when the dock is empty. These piles, each 60 feet long and weighing 3,420 lbs. were spaced about 6 feet longitudinally and 5 feet transversely throughout the dock floor area. They were driven to a cut-off elevation of—47.3; that is, the point of the 60-ft. pile is 107.3 feet below low water.

Pile Driving

For this pile-driving operation we built steel leads to slide within the standard wooden leads of a floating pile-driver, thus forming, when lowered, the submarine extension of a telescopic unit. To place the pile in this unit the submarine extension was raised clear of the water. The pile was then set in the lead. A hinged gate was pinned closed around the bottom of the pile with the top being held fast in a 20-in. pipe sleeve hung from an 11B3 McKiernan-Terry hammer. The submarine lead was then lowered. These piles had to be driven with a tolerence of not more than 7in. from their blueprint location.

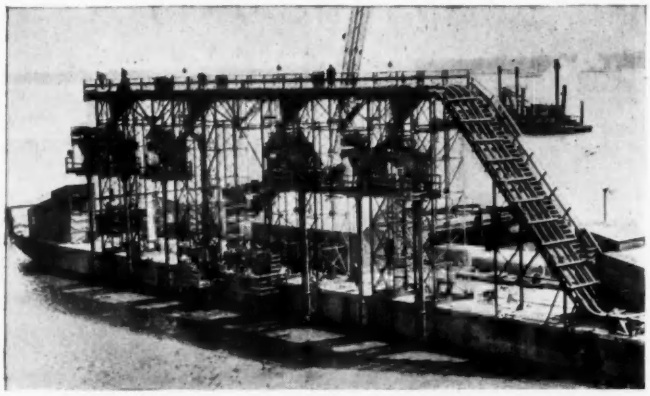
To get this accuracy there was devised a system whereby 6-in. by 12-in. batter-boards extending the full length of the dock were erected on each side. Between these batter-boards at surveyed points a 3/16-in. cable was stretched. This cable was calibrated for sag and had fastened to it a marker for each pile position. There was also another marker which was spotted daily on the centre line by instrument. On the front of each pile-driver was hung a working platform with a hole for the submarine lead to pass through. The 3/16-in. cable for locating the piles was placed 6 feet from the centre line of the submarine lead and a plumb-bob hung from this cable was brought over a point on the working platform. This, with the use of a large square, accurately located the pile. The boat was kept trim so that the leads remained vertical.

The whole series of these giant docks will have approximately the same plan dimensions, that is, 1,100-ft. in length, by 150-ft.

*This article, reproduced by kind permission from *Construction Methods* for August, 1941, was published before the completion of the work in question and therefore much is written in the future tense.

Subsqueous Dry Dock Construction—continued

inside, and 40-ft. more or less in depth. The thicknesses of the floor slabs vary, depending upon the hydrostatic pressure they have to sustain. The floor slabs of the Philadelphia drydocks are of tremie concrete 14-ft. thick. The lower portion of the walls is also tremie concrete 15-ft. thick for a height of 44-ft. Embedded 2-ft. in the top of the tremie wall is a continuous 20-ft. bulkhead of Weirton steel sheet-piling which extends 18-ft. above the concrete. This sheet-piling will, when the dock is dewatered, act



Steel Barge supporting concreting apparatus and shoots.

as a cofferdam to hold out the backfill while the dry concrete work in the side-walls and the floor is being completed. In the floor of the dock a 2½-ft. slab will be placed, with a 2-ft. veneer for the side walls. Above the tremied side walls the second lift of the concrete will be placed in the dry, and will contain the pipe tunnels and working gallery for the many utilities required to service the building of battleships. In the 2½-ft. lining in the floor of the dock will be placed the sewerage and drainage systems, and inserts for securing the 500-odd keel blocks necessary to support a vessel.

To facilitate early keel laying a temporary cofferdam, 860-ft. from the head of the dock, is being erected. This will permit the Navy to start construction on the middle portion and stern of the ship, which involve the most difficult and long-time work. A cofferdam will be built around the caisson gate seat at the outer end of the dock for the completion of this portion of the work. When the caisson gate has been placed, the temporary bulkhead will be removed, and the remainder of the dry concrete will be placed to finish the inside of the dock.

Three 54-in. pumps, with the capacity of unwatering either dock in 2-hr., will be placed in an underground pumphouse between the two docks.

For tremie concrete floors forms a design was prepared on the basis of pouring sections 12-ft. wide across the dock. The result can be accepted as a form for reinforced concrete of the following dimensions: 12-ft. wide, 14-ft. high, and 184-ft. long. The form was designed as a self-supporting, two-point pick-up box truss, with the chord members of the truss acting as a part of the reinforcing. Additional reinforcing, consisting of angles and 2¼-in. square bars, was welded to the box truss in proper positions. The inside face of the box truss was lined with 3½-in. corrugated sheeting manufactured by United Steel Fabricators, Inc., of Wooster, Ohio. The complete form, with all reinforcing attached, weighed from 80 to 130 tons. This difference in weight is due to modification in the design to provide for carrying drainage systems and end forms.

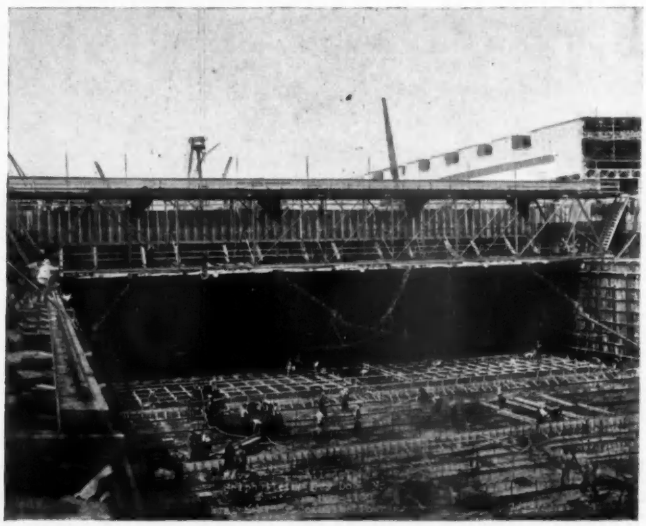
The structural steel trusses were purchased semi-fabricated in three paired sections. These sections were unloaded from cars and placed in a horizontal position on special trucks. The trusses were then covered with the corrugated sheeting and the entire unit was moved into a special welding building, where the corrugated sheeting was spot-welded to the truss units. This spot welding was accomplished by using specially designed Taylor-Winfield pulsating-resistance welders, commonly known as the "woodpecker system." Two welding sheds were placed side by side so that a pair of units, after being welded, would arrive in the erection bay parallel to each other and opposite hand. The erection crew then would stand the paired units in a vertical position on two 12-ft. gauge track dollies placed 150-ft. apart, and on two temporary supports, thus forming the sections. Three sections next were welded together to form a box. Lincoln d.c. arc welders were used in assembling the forms and fixing the reinforcing.

As the assembled box moved the 300-ft. to the launching pier, additional crews placed the bracing, the form ties, and the reinforcing steel, all of which were entirely welded. The completed box was then taken over by the tremie-truss-placing-crew. The tremie-truss-placing unit was a revamped car float with specially desiged shear-leg derricks placed on each end of the boat and 150-ft. apart. This hoisting and placing unit was used to lift the completed form from the launching dock to a scow. The box then was towed to its location in the dock where the shear-legs placed the form below water in its final resting position. Two divers were used in the placing operation of these truss units, and a tolerance was attained not exceeding 2-in. in any direction. The dock floor required 47 of these truss units.

The side-wall forms were built with the use of channels back to back for walers, and 1¼-in. bolts for tie-rods. The operation of building these was similar to the floor truss assembly, using two other welding sheds for the fixing of the corrugated sheeting to the channels. These sections weighed about 30 tons each, and were loaded off a dock parallel to the bottom form dock by a Manitowoc Speedcrane. A 1085 American Revolver crane on a scow placed the forms in the dock. There are 65 wall forms, averaging 36-ft. long, per dock.

Concreting Barges

For concreting the floor of the dock a steel car float 337-ft. long by 47-ft. wide was used. Eight Insley towers were erected at 19-ft. 3-in. centres. These had the regular Insley sliding frames to each of which was attached a 3-yd. hopper, from which, in turn, was suspended a 12-in. tremie pipe. Above these sliding frame hoppers and between alternate pairs was placed a 3-yd.



Placing concrete on floor of dock.

hopper which, with a pants-leg below it, could feel either sliding frame hopper. This top hopper was fixed, and from each end of the pants-legs was suspended an Insley elephant trunk, which was removed or added as the sliding frame hopper went up or down.

Concrete was fed to the four top hoppers by four lines of 8-in. Pumpcrete pipe, which were elevated 41-ft. above the deck, so that at any time we could place concrete from any pipe into any hopper. This gave flexibility. If there was trouble at the batch-

Subsqueous Dry Dock Construction—continued

ing plant, we could take concrete from any one of the pipes, and, if we needed a lot of concrete at a hopper at any one time, we could concentrate the discharge from as many pipes as we wished. Two 4-drum gas engine Lidgerwood hoists were used for the eight Insley sliding frames.

Dredged Basin with working plant.

For tremieing the side-walls, another boat, 100-ft. by 30-ft. was rigged in a similar fashion, with the exception that it had only two tremie lines, and these projecting over the rake of the scow.

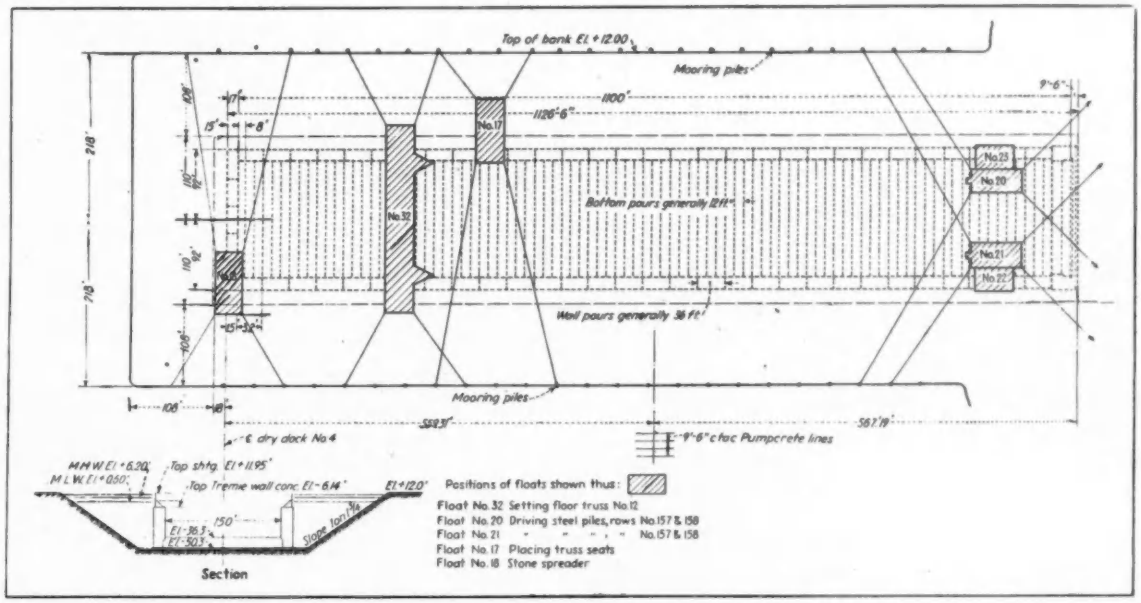
Novel Tremie Method

As everyone will testify who has undergone the travail and sorrow involved, the placing of tremie concrete is a headache, and where a large quantity, such as 300,000 cu. yds. is concerned, it can readily become a major catastrophe for the peace of the job. You must have an experienced and well-trained crew who know how to manœuvre pipes and holding the losing of seals to the minimum, and even with a well-trained crew, the loss of a seal is not unusual. The loss of a seal means a structural flaw in the concrete, brought about by the inrush of water at the bottom of the tremie pipe, and by the jetting action when recharging the pipe for a new start.

On the tremie work for the drydocks the customary method of using a gunny-sack filled with straw or an excelsior wad placed in the pipe ahead of the first concrete, was prohibited. Also, since the Navy in this type of work removes all concrete in the pour if the seal is lost, it became necessary to devise a method which eliminated the shortcomings of the ordinary tremieing procedure.

The novel and effective means developed for placing underwater concrete we call the "valve tremie process." It is easily applicable to any tremie job and, once working, is simplicity itself. These particular tremie pipes are 12-in. spiral welded 3/16-in. wall, made by the American Rolling Mill Co. They are welded flanged pipes, and when in position are 60-ft. long. A tremie pipe is attached to the 3-yd. hopper in the sliding frame. A 12-in. plug-cock valve, closed and opened by pipe control, is installed 35-ft. above the lower end of the pipe to serve as a gate. (The location of the valve is determined by the hydrostatic head to be overcome). Immediately below the valve an air-hose connection is tapped into the pipe.

In starting the pour for the tremie concrete the sliding frame with the pipe suspended from it is raised until the valve is out of the water. Then, with valve in closed position, the pipe and the hopper above it are filled with concrete. The sliding frame then is lowered until the bottom of the tremie pipe reaches the stone fill at the bottom of the dock. It is next raised about an inch

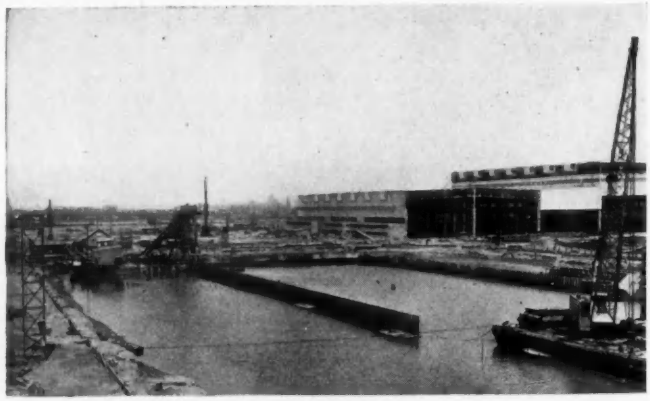


The Co-ordination of Floating Equipment within Dredged Basin is indicated by this diagram of a typical day's operations for placing tremie concrete, showing locations (cross-hatched) of Float No. 32, setting floor truss form No. 12, Floats No. 20 and 21, driving steel piles; Float No. 17, with revolving crane placing truss seats; and Float No. 18, with revolving crane spreading stone for floor base.

to permit the free escape of the air and the descending concrete, and to eliminate the danger of back pressure from the compressed air which would arise if the pipe were firmly seated on the bottom. Two divers work on the concreting barge at all times and are

Subsqueous Dry Dock Construction—continued

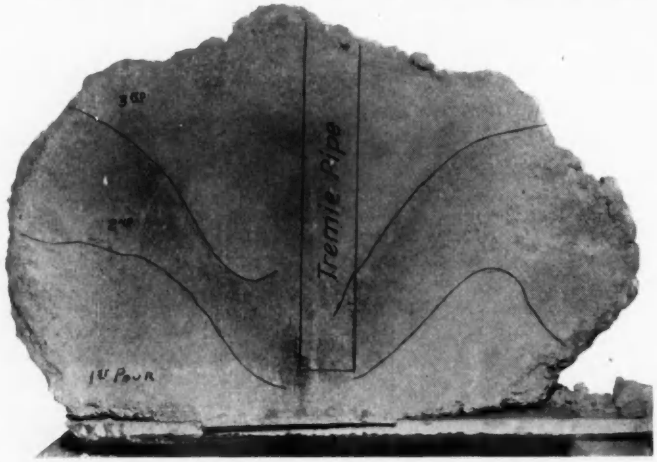
responsible for the proper placing of the pipe in the tremie forms. Upon the diver's signal that all is ready, the air valve is turned on. The valve and the plug of concrete above it prevent any air from escaping upwards, with the result that all water in the pipe below is ejected, and a bubble is formed on the bottom of the



Piled Enclosure for Dry Dock with Tremies mounted on barges.

pipe of the same shape as that formed on the top of a glass tumbler by capillary action. The 12-in. plug-cock valve then is opened and the operator on the platform of the sliding frame opens the hopper, and keeps the concrete flowing until the pipe becomes full. This platform operator has a telephone connection to the engineer on the 4-drum hoist that controls the movement of his sliding frame. At his command, the engineer raises and lowers the hopper to permit the steady flow of concrete.

Tremie Placement Tested by Model—In order to test the scheme, a glass-enclosed scale model of the tremie set-up was built in a field laboratory and the system worked out in detail. This accounts for the foregoing description of what happens underwater. In this laboratory we have used different coloured batches of concrete in a comprehensive study of the spreading action of the concrete as the pour progressed. These studies served to alter our conception of the shape tremie concrete takes after it leaves the bottom of the pipe. We thought that the concrete coming out of the tremie pipe would burrow under the surrounding concrete, but our coloured batches showed us (see accompanying



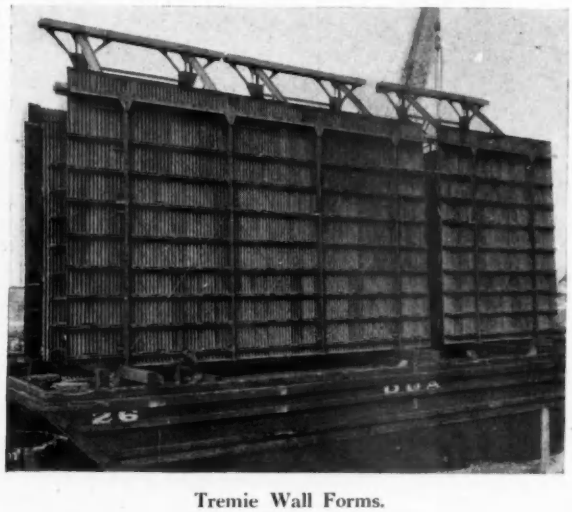
Section of Concrete showing layers of different "pours."

photographic detail) that the succeeding concrete takes the form of plumes—that is, one on top of the other, with the last concrete being on top. After the procedure had been worked out, foremen divers, and crew members who were to work on the tremie boats were called into the laboratory and put through a course of instruction to familiarize them with the system. Here each man learned the why and how of his specific duties, so that when we started tremie operation on the boat, he knew what was going on below water.

The efficiency of the new system is attested by the fact that not a seal has been lost up to this time, during which we have placed 130,000 cu. yds. of submarine concrete in 7 weeks. If a seal had been lost, it would have been a simple matter to regain it speedily without the usual danger of impairing the structure, as there would be no jetting action in making a new seal. While it is true that this method of tremieing will effect a tremendous saving in dollars, when multiplied over all the dock projects that the Government now has under way, the time element reduction is of more vital significance. On similar docks, heretofore, it took hours to charge a tremie in a manner satisfactory to the authorities. By the valve tremie process, we do it in a few seconds by opening a valve.

Central Mixing Plant

Selection of a batching and mixing plant capable of handling 250 cu. yds. of concrete per hour, economically and with a minimum of labour, was a subject of intensive research and layout work. The plan installed has justified this care and forethought by more than living up to expectations in every respect.



Tremie Wall Forms.

To start at the point of material delivery, aggregates are freighted in by water in 1,000-ton scows from the Warner Co.'s plant at Morrisville, Pa., and transported from these barges into six 300 cu. yd. storage bins by means of a 1085 American Revolver crane, equipped with a 3 cu. yd. bucket. These hoppers are set over a 36-in. Jeffrey belt conveyor, 342-ft. long, and were installed in preference to stock piling in order to speed up bin charging and to facilitate heat control for winter concrete. All bins are equipped with steam jets.

Two of these bins are used for sand and four for coarse aggregate which consists of river gravel graded down from 1½-in. commercial size. The lateral conveyor under these bins feeds into a transfer house and then, at right angles, on to a 447-ft. riser belt with a vertical lift of 35-ft. This riser belt discharges into a four-equal-sized-compartment, 517-cu. yd. Butler bin. One compartment of the bin is for cement, one for sand, and the other two for gravel. This bin was erected on the transverse centre line of the dock and set back on piling about 90-ft. from the top of slope. Bulk cement is delivered in bottom-dump railway cars and transferred by twin-screw conveyors to two 250-bbl. per hour Rex bucket elevators, which carry it to the top of the bins. When the cement bin is full, the overflow goes into a 3,000 bbl. ground storage bin which is set over the conveyor flights.

Subsqueous Dry Dock Construction—continued

Three Dual-Drum Mixers

The concrete plant is equipped with automatic Butler 4-beam scale and weigh batchers for charging three 34-E Koehring dual-drum mixers, which in turn top four 200-double Pumpcrete machines. Each of the three mixers is so arranged that it can be discharged into either of two adjoining Pumpcrete pug-mill re-mixers by means of a swinging spout. All the equipment is electrically powered and, so far as possible, automatically controlled. This plant, on a 1½-min. mix, has a capacity of 260 cu. yd. per hour, providing a safety factor which will allow a pour to continue at normal speed in the event of a mechanical breakdown with any one batching, mixing or pumping unit. To date there have been no mechanical difficulties and, with the trained crew we now have, we do not expect any.

Pipe Line Transportation of Concrete

Concrete is pumped through 8-in. pipe lines up to 1,000-ft. in length, to the receiving hoppers set above each pair of tremie pipes on the tremie barges. Allowing for the elbows and the vertical lift, we have pumped up to a horizontal equivalent of 1,450-ft. Individual pipe lines have a 10-ft. flexible section from shore to barge, in order to compensate for the rise and fall of the tide.

The concrete pump and pipe line system was readily adaptable to this job as it gave a uniform and continuous distribution of unsegregated concrete at the tremie hoppers. However, the outstanding advantage of the pumping system lies in the co-ordination that can be effected, as there is no confusion or interference between the place of manufacturing the concrete and its point of deposit. This point will be more readily appreciated when it is understood that the entire job was so laid out that the location of each working unit, such as the concrete boats, the pile-drivers, the stone scows, and the derrick boats, was designated and co-ordinated months in advance. A typical day's diagram is shown with this article.

For the construction of Dock 5, the concrete plant will be moved to the centre line at the head of the docks, and two more concrete pumps will be installed as boosters.

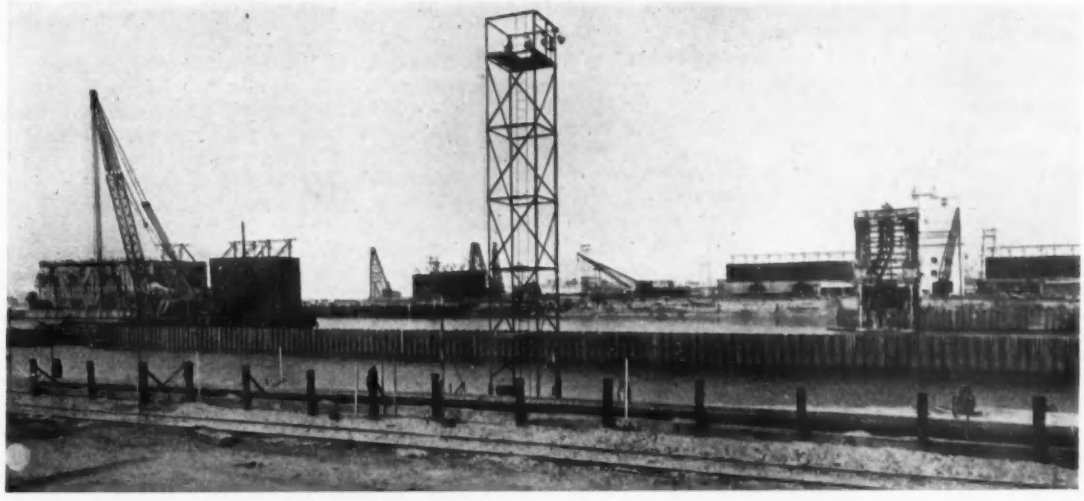
Concrete Progress

Except for the first day, when the more or less usual difficulties that arise in co-ordinating various plant operations were encountered, each pour was made on schedule. Production was stepped up rapidly until we reached the peak of 3,600 cu. yd. in a day. However, this rate was crowding the form design, and we stepped down to a schedule of about 2,700 cu. yd. daily.

Two sections of bottom forms were poured daily in two 8-hour shifts—that is, one section, containing 1,000 cu. yd., per shift. Concreting on the wall pours progressed around the clock. These wall pours are 36-ft. long, 15-ft. wide, and 44-ft. high, and require approximately 850 cu. yd. each. The wall sections were poured at the averaged rate of 60 cu. yds. per hour with one Pumpcrete, while at the same time work was carried on with three machines on the bottom slab. After the slab was completed a second pumping unit was cut into the wall pours in order to get the full output of one 34-E dual-drum mixer. We could, therefore, increase our production to approximately 80 cu. yds. per hour for finishing the wall pours.

Pour operations started March 4, 1941. The exact quantity of concrete required to complete the job has not been determined, as we are still designing the quay wall and the service building, but the total quantity will probably be in the neighbourhood of 500,000 cu. yds.

Five dredges have been placing back-fill outside the walls and steel sheeting of Dock 4. The cofferdam cut-off at the 860-ft. mark is rapidly nearing completion. The programme schedule provided for pumping out the foreshortened drydock and resuming concrete operations on the lining and top-wall lifts in July (1941). It is a point of justifiable pride that the entire organisation has functioned as a well-oiled machine in stepping up the tempo of an already exacting construction schedule. In our relations with the Navy there has been no evidence of red tape, but a strong desire to get the work done. To this end we have been blessed by having the closest kind of co-operation. By early Autumn, Uncle Sam will be laying a new keel.



Derrick (at extreme left) placing steel form for dock wall. Tremie (at right) placing under water concrete.

Personnel

For the Navy Department the key personnel on the Philadelphia drydock project includes Rear Admiral A. C. Watson, commandant, Philadelphia Navy Yard; Capt. Gaylord Church, district works officer; Commander W. Z. Kline, assistant public works officer; and Lieut. G. T. Lowe, resident engineer officer in charge. Frederic R. Harris, Inc., and Dry Dock Engineers acted as consulting engineers.

The organization of the contractor, Drydock Associates, comprises Frederic B. Spencer, project manager; D. B. Young, job manager; William Denny, general superintendent; James T. Denton, chief engineer; W. O. Keehn, engineer and superintendent of structural steel; W. F. de Leon, office manager; Byron Hunicke and Jack Aroyan, in charge of design; Joe Wigmore, in charge of architecture; Harry Hinkel, dredge superintendent; George Holmes, mechanical engineer; Art Ruge, engineer of Executive Committee; Joe Durfee, chief of field parties; Walter Carter, chief accountant; Frank Smith, electrical engineer; and Chris Knoeller, paymaster.

The Coromandel Coast of South India

Sand Travel along the Coast. Wave Bars at the Mouths of Estuaries.

By J. M. LACEY, M.Inst.C.E.*

(Concluded from page 214)

Early observations at Madras in connection with the proposed Harbour

Within the 6 fathom limit, the level of the shifting sand, with reference to fixed objects, such as anchors, posts, etc., is variable; there was no variation beyond the 6 fathom depth. In taking soundings along the old screw pile pier, for a series of years, it was ascertained that the depth of sand at the pier head varied as much as 8 feet at different seasons of the year; and that when there was an increase of sand there, the quantity at the shore end is diminished, and the water was considerably deeper; also that as the sand accumulated at the shore end it was washed away at the Pier head. The screw pile Pier was erected in 1858, and had a length of 1,100 feet, 42 feet broad, with a **T** head 160 feet long running north and south; the depth of water at the **T** head being estimated at 3 fathoms at Low Water. Projecting as it did beyond the actual breaking surf, it enabled cargo to be landed precariously in tolerably smooth water, with less risk than was involved in passing it ashore through the surf. The Pier was dismantled in 1917 to make room for the "Construction of the West Quay of the Madras Harbour" (Proc. Inst. C. E. Vol. CCVI, pp. 23 and 24).

Mr. W. Parkes, M. Inst. C. E., who was sent by the Secretary of State for India to investigate the possibilities of a harbour at Madras, has stated that at Madras the shore advances from March to October, and recedes from October to March. That is advances during the south-west monsoon, and recedes during the north-east monsoon. (Records of the Government of India, CCVI P. W. D. Serial No. 5, Papers on the Madras Harbour, Calcutta 1885).

The Harbour at Madras has already been described in *The Dock and Harbour Authority* for October 1940, under "Harbours and Ports of the Circar and the Coromandel Coast of south India."

The result of the construction of the harbour has been a vast accumulation of sand south of the harbour. "The rapidity of deposition, and the enormous quantity thrown up during the south-west monsoon were almost incredible." Consequently when there is a projection or promontory like the Madras Harbour, which cuts off the supply of sand from the southward, the sea must necessarily encroach on the shore to the North of it; the farther side, being deprived of its protecting margin of travelling sand, on which the surf expends its energy, was rapidly eroded. The erosion was tremendous: "villages, almost towns, and sacred burial places of natives had been washed away"—"every sort of protection had been put down. Groins had been useless, because there was nothing to catch; the "Harbour had caught everything[11]" The erosion north of the Harbour extends for a distance of over 3 miles. For a distance of 1¾ miles North of Madras, where the land is valuable, further erosion has been stopped by heavy stone revetments. (See Proc. Inst. C. E. Vol. CXCIV. "Coastal Sand-Travel near Madras Harbour" p. 167).

The movement of sand along the Coromandel Coast near Madras is described and discussed in the "Proceedings of the Institution of Civil Engineers Vol. CXCIV, p. 153 et seq., under "Coastal Sand-Travel near Madras Harbour," the consensus of opinion being that wave action was the cause of the sand travel. Mr. W. Parkes, the designer and subsequently the Engineer in Chief of the Madras Harbour, has given his opinion that the movement of sand at Madras shows clearly that the waves alone striking the shore obliquely are the real transporting agency. His arguments are given on pp. 157, 158 and 159 of the Proceedings quoted above. The sand is described as "all quartz sand and shell fragments" on p. 230, and an analysis of the sand within the 6 fathom contour is given on p. 160 of the above quoted Proceedings, viz.

Leaves 2 per cent. on a sieve of 50 meshes to the inch,
Leaves 3 per cent. on a sieve of 70 meshes to the inch,
Leaves 75 per cent. on a sieve of 100 meshes to the inch,

and 20 per cent. passes through the sieve of 100 meshes to the inch.

It is described as too coarse for the along-shore current to carry far in suspension, but can be transported by wave action.

Sir Francis Spring's proposal for the extension of the south Arm of the Harbour to prevent the enveloping action of the sand, (see "Suggested Action" p. 168 of the Proceedings already quoted) was completed in 1926.

The extension of the south Arm called the "sand screen" was at first a success. The hydrographical observations of the coast north and south of the Harbour, which were initiated in 1931, show, that in 1939 the contours North of the "sand screen" had advanced considerably eastwards, and northwards of their position in 1925. The "sand screen" was now practically enveloped in sand, and was becoming less effective as a trap each year. It was feared that as the Harbour had interrupted the northward flow of sand, nature, in endeavouring to overcome the interruption, would cause, eventually, a sand bar to be formed across the harbour entrance, if nothing was done to arrest the northward drift. The latest Report of the Madras Port Trust i.e. for 1940—41, under "Hydrographical Observations" states that comparing the contour of 1941 with that of 1940 shows considerable silting north of the "sand screen" where just over 100,000 tons have accreted in the twelve months. South of the "sand screen" along the coast as far as San Thomé, a distance of 5 miles, the accretion in the twelve months has been 900,000 tons.

The erosion North of the Harbour has been going on fairly steadily ever since the rough stone revetment was completed. The revetment appears to aggravate the erosion further North. At the village of Cassimode, about two miles North of Madras, where the stone revetment ends, the erosion averages 30 feet a year. Some few years previous to 1939, the revetment was extended to protect Port Trust property, and since its extension, the erosion at the point where the revetment ends has been considerably accelerated. Surveys of the shore movement, North of Cassimode where the land is being rapidly eroded, indicate that the accretion south of the Harbour roughly balances the erosion on the North.

Regarding sand being carried away in a northerly direction, the sand is moved more by wave action than by littoral currents. This is evidenced by the way it is driven along the eastern breakwater by the action of the waves of the south-west monsoon. Some sand is carried in suspension by the littoral currents, but from cross sections taken at regular intervals for over 25 years, it is fairly conclusive that the greatest movement takes place just about Low Water mark when the wave action is strongest.

Effect of the North-east Monsoon

Current observations taken during the north-east monsoon indicate that its direction is due south and follows the configuration of the eastern breakwater, and the shore south of the Port. Cross sections taken at intervals before and after the north-east monsoon reveal that the action of the waves during this time of the year is to tear down banks and beaches, and deposit the sand so re-

10. See Mr. Thorowgood p. 243, Proc. Inst.C.E., "Sanding up of Tidal Basins," Discussion, vol. clvi.

11. Ibid, p. 245.

Coromandel Coast of South India—continued

moved seaward and south-east of its former position. Just south of the Harbour, the Low Water line erodes between 200 and 300 feet each north-east monsoon, and the sand so removed is deposited seaward and within 800 feet of the beach. During the north-east monsoon all beaches erode north and south of the Harbour.

Regarding the variation of the depth of sand at the head of the screw pile Pier, and the advance of the shore line during the south-west monsoon and its recession during the north-east, the surveys show that close to the beach, which is just south of the Harbour called "Parry's Beach," the depth of water varies as much as 8 feet between the end of the South-west monsoon and the end of the north-east. Opposite the East Quay, or what was the original entrance to the Harbour, on the sea side, the difference in soundings between January and July is 10 feet, which confirms the early observations.

The question why the shore advances during the south-west monsoon, and erodes during the north-east; and why during the latter monsoon the sand north of Madras should not be swept southwards, and be piled up against the north Arm of the Harbour has never been satisfactorily explained. The paper "Coastal Sand Travel" in the Proceedings of the Inst. C. E. already quoted states on p. 155 "undoubtably this is the sand which is washed up and down the coast alternately by the waves of the two monsoons." But from the evidence produced little sand is carried southwards.

Major Cotton in his report on the encroachment of the sea at Vizagapatam, already quoted, states that the effect of the surf during the north-east monsoon in moving the sand is very slight so that on the whole the sand is continually carried northward. The hollow north of the natural groin of rocks (X Fig. 4B) has never filled up. The only effect of the north-east monsoon is to extend the Low Water line further seawards. The action of the surf during this monsoon causes the Low Water line to form a tongue of sand opposite the mouth of the creek, tending to form a bar across the mouth; and the contest between the surf and the tidal ebb and flow continues until the southerly wind sets in, when this bar is flattened back over the mouth, (Fig. 4B).

Mr. A. T. Mackenzie in his report "Vizagapatam Harbour Investigation, November 1898 to November 1899," states that there was a general opinion that the Dolphin's Nose trapped all the sand carried northward by the south-west monsoon, but his observations show that at the end of February when the wind begins to blow from the southward, there is a marked influx of sand which can be seen pouring over the reef at the Dutch Battery (Fig. 4B). Standing on the Dolphin's Nose, 536 feet above the level of the sea, on a bright day, the sand close to the rocks may be seen held in suspension by the water. This drift of sand northward at Vizagapatam is confirmed by Mr. W. C. Ash, see Vol. 1, (1935-36) Journal of Inst. C. E. Vizagapatam Harbour, p. 242-244. Mr. Mackenzie also notes the absence of any movement of sand southwards during the North-east monsoon. The conclusion arrived at is that the drift of sand is entirely northward, along this coast. The quantity must be great. Was the sand merely drawn down to a position below wave action during the north-east monsoon, to be gradually drifted back again during the south-west monsoon? Or does the "sand-drift" along this coast travel with the flood tide? (see W. T. Douglas "Coast Erosion" Proc. Inst. C. E. Vol. CLXXXV).

Rivers

The only river of importance of the rivers along the Coromandel Coast, which discharge their contents into the Bay of Bengal, and which has an abundant supply of water all the year round is the Cauvery (Fig. 1). The river rises in the Coorg hills on the West Coast of the peninsula, and receives the full benefit of both the South-west and the North-east monsoon rains. At Trichinopoly the river divides: the northern branch, called the Coloroon enters the sea south of Porto Novo, the southern branch, called the Cauvery, divides again into two branches, called the Cauvery and the Vennar, which again are sub-divided into numerous branches, and irrigates by direct flow the whole of the Tanjore delta, an area of nearly a million acres of paddy (rice) land.

The catchment basins of the other rivers, along the Coromandel Coast, which discharge their contents into the Bay of Bengal, depend for their supply chiefly on the north-east monsoon rains. High floods in these rivers never occur except during that monsoon. Such floods are of short duration, and usually take place only at intervals of some years, when a cyclone crosses the coast (see Proc. Inst. C. E. Vol. CLXXI, p. 360, "Floods in South India"). Low floods annually occur in all rivers during the North-east monsoon, (unless the monsoon is a failure) and keep up in some rivers for long periods of time. The floods, due to the south-west monsoon rains, are insignificant, in these rivers, compared with those due to the north-east monsoon rains, and rarely rise much above the line of High Spring Tide; whereas the floods due to the north-east monsoon rains often rise as high as 9 feet above High Spring Tide.

The source of the sand along the Coromandel Coast is ascribed to the detritus of the rivers, the Penneru, the Palar, and the Cauvery, besides that due to the smaller rivers which add their contribution. (See p. 158 Proc. Inst. C. E. Vol. CXCIV "Coastal Sand-Travel near Madras Harbour"). As pointed out above the only river of importance which carries water all the year round is the Cauvery. The Penneru, the Palar and the smaller rivers are dry beds of sand during the greater part of the year, so that the enormous quantity of sand, some one million tons a year, carried along this coast by wave and current action cannot be due entirely to the detritus of these rivers. Ordinary sea sand, besides being the detritus of rivers and coastal erosion, contains a large quantity of marine shell in various stages of comminution, the beach being formed of the fragments swept up by the action of the sea.

The comminuted shell is heavy, and not easily moved by moderate currents, unless assisted by wave action. (See Mr. W. Dyce Cay correspondence on "Harbours of South Africa" p. 58, Proc. Inst. C. E. Vol. CLXVI). The sand must have a more distant origin. In this connection see the Proceedings quoted above, "Harbours of South Africa," which state that sand on a vast scale is carried along the Coast of South East Africa, and there are no rivers of any importance discharging their contents along that Coast. See also Proceedings of the Inst. C. E. Papers 3910 and 3881. "Harbours of New South Wales" Vol. CLXXXIV, and Vol. CXLI, "Suez Canal" and p. 226 Vol. CXCIV "Sand-travel on the West Coast of Jutland."

Wave Bars

All rivers and estuaries along the Coromandel Coast have sand bars thrown up by the action of the surf across their openings into the Bay of Bengal. They are liable in all but the largest backwaters, and large rivers passing floods of both monsoons, to annual closure.

With the first heavy flood of the north-east monsoon the great majority of the bars, along the whole length of the Coromandel Coast, whether open or closed are heavily scoured, and forced fully open by the rush of flood water, and remain open until March or April, during which period tidal conditions prevail. In rare cases failure of the usually heavy north-east monsoon rains results particlarly in large backwaters which act as flood moderators in bars not opening at all. Along the Coromandel Coast from March to October, the bars of all rivers and backwaters south of, and inclusive of, the Swarnamuki River, 75 miles North of Madras, close annually, except the bars of the Pulicat Lake, and the Palar River. Sea bars north of the Swarnamuki River generally remain open all the year round except in cases of insignificant rain-fall, (History of the Buckingham Canal. Govt. of Madras publication).

Where the tidal backwater, or river estuary is deep, the tide is propagated in a short time many miles inland, there being a free propagation of the tidal wave. Where there is little depth, the tidal wave is throttled and degenerates into a tidal current, travelling with low velocity. The rapid rise of the tide water is dependant not on the width but on the depth of any channel in conection with the sea. The opening and keeping open of the seabars is of great importance, (1) for the supply of tide water to the estuaries, and backwaters, and (2) for the discharge to the sea of land floods.

Coromandel Coast of South India—continued

All the bars are purely wave bars formed by the unceasing action of an exceptionally heavy surf on a shallow sea floor com-

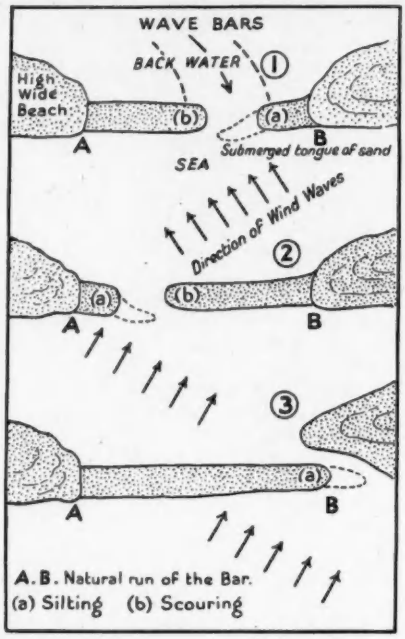


Fig. 5. Diagram showing action of surf at mouths of estuaries on Coromandel Coast.

posed entirely of sand, and therefore easily moved. The waves driven on by the wind strive to pile up the sand at the mouth of the outlet, and there is a contest between the tidal action, and the tongues of sand thrown up by the surf, tending to close the opening. With the first flood of the north-east monsoon, all bars are opened naturally, or can be cut open. The advances of the wind and the waves being from the north, (N.E. monsoon) the tongue of sand thrown up by the surf tends to close the opening, which is gradually driven southwards (Fig. 5, 1). In the hot weather, as little rain falls on the Carnatic, most bars are kept open by tidal action. With the setting in of the southerly, and the along-shore winds, the wind and waves drive the opening northwards, (Fig. 5, 2) until it is driven against the high wide beach, and can progress no further, the mouth of the opening running parallel with the coast line for some distance, (Fig. 5, 3) when the opening is closed, only to be opened again during the north-east monsoon floods. In cases where there is deep water, and sufficient tidal capacity behind the bar, the contest continues, until the north-east monsoon floods scour out the opening again, and it starts on its southward journey. In the case of the smaller rivers the opening never has a chance to move northward, as owing to insufficent tidal capacity, the opening closes before the southerly winds set in.

Under the influence of the southerly winds, the general tendency for all outfalls on the Coromandel Coast is to move northwards. When this northerly movement has reached the limit of its run, the openings generally close, and open again during the north-east monsoon rains, when land drainage comes down, wherever the deep channel to the sea is best defined. This is usually about the middle of the run. The outfalls move southward during the few months of that monsoon remaining after the flood, but are again driven northward when the southerly wind sets in. The net result is that outfalls on this coast are usually to the North, and in cases of river outfalls which never close, are usually permanently so. In cases where the openings to the sea never have a chance to move northward, the outfalls are usually to the south[12].

12. See "History of the Buckingham Canal," A. S. Russell, 1898 (Government of Madras publication).

Review

An Introduction to Concrete Work, by H. L. Childe. Pp. 133, with diagrams and illustrations. Price 1s. 6d. London: 1943. Concrete Publications Ltd.

Of the popularity of concrete as a constructional material there can be no question and its use is not only universal, but is of constantly increasing applicability to all kinds of engineering and building operations. Concurrently, of late years, there has been a marked output of books on the subject of the composition and treatment of concrete, ranging from erudite treatises for the scientific expert to simple manuals and text-books for the practical worker in the material. A glance at the bibliography at the end of the volume under review (it is by no means an exhaustive list) is sufficient, to show how wide has been the demand for direction in manipulative processes.

Mr. Childe's little booklet of pocket size and some 130 pages in extent, is a useful addition to the literature on the subject, because it is handy in form, concise and methodical in statement and contains a variety of data and memoranda for convenient reference. As stated in a preface facing the title page, it is "an outline of the principles of concrete and reinforced concrete construction, written for students at technical schools, apprentices in the building industry, builders, foremen and others who require a simple and practical introduction to the subject as a preliminary to more advanced study."

The table of contents is comprehensive and includes a general introduction on "good concrete," followed by an analytical description of the various ingredients and of the means for their effective combination. The theory and practice of reinforced concrete are also consisely explained and notes are given on modern methods, illustrated by a number of photographs taken on building sites in order to demonstrate actual working processes and conditions.

In making one or two critical comments we have no wish to be unduly captious. The booklet is obviously kept within limits of usable compactness, and cannot be gauged by the same standards as an elaborate treatise, but we miss any reference to the use of large stone "plums" or rubble introduced into mass concrete in order to economise material and the section on water-content (which is one of the more controversial features in concrete mixing), in estimating a water-cement ratio of 0.67 for a batch of typical mix, gives no numerical value to the appreciable quantity of moisture which may be contained in the sand forming part of the aggregate. All that is said is that "any water contained in the aggregate should be included in the calculations." This we suggest is a trifle vague. The author confines his observations to Portland and "high alumina" cements and makes no reference to Roman and other natural quick-setting cements, which at one time occupied an important place in the builder's yard.

But these comments do not seriously detract from the merits of the publication. Within its range and purview we can commend it as a handy *vade-mecum* for all who are engaged in concrete work in its many forms in open air construction.

Clyde Navigation Trust.

At the first meeting in the New Year of the Clyde Navigation Trust, Mr. Frederick C. Stewart, one of the Trustees, was congratulated by the chairman (Mr. William Cuthbert) on receiving the honour of knighthood. Mr. Cuthbert also extended congratulations to Capt. Eaglesome, harbour master and traffic superintendent, and to Capt. John D. MacPherson of the Clyde Pilotage service, both of whom have been awarded the O.B.E.